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NAVSHIPS 0969-245-9010 *(Non-Registered)*

TECHNICAL MANUAL

for

SIGNAL GENERATOR SG-376A/U

DEPARTMENT OF THE NAVY

NAVAL ELECTRONIC SYSTEMS COMMAND

Approved: 10 October 1967

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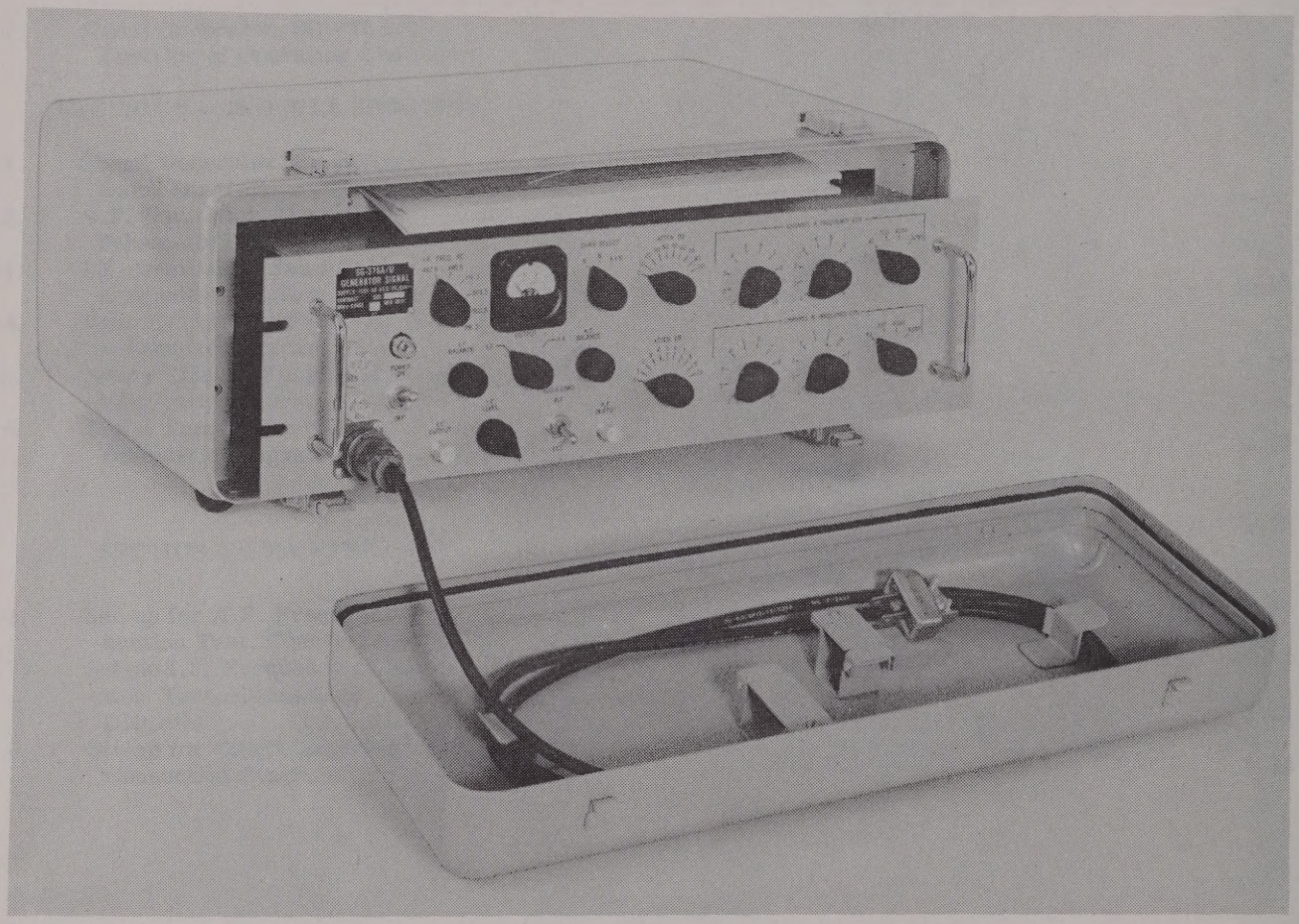


Figure 1-1. Signal Generator, SG-376A/U

SECTION 1

GENERAL INFORMATION

1-1. SCOPE.

This Technical Manual is in effect upon receipt and does not supersede any previously issued publication. Extracts from this publication may be made to facilitate the preparation of other Department of Defense publications.

1-2. GENERAL DESCRIPTION.

The instrument covered by this Technical Manual is a portable signal generator specifically designed for testing Single Sideband Radio Communication equipment and Spectrum Analyzers used for their maintenance. It may, however, be used as an audio and radio frequency signal generator for other purposes.

This instrument consists of two variable frequency audio signal generators and two dual-frequency intermediate radio frequency (I.F.) signal generators. The A.F. and I.F. signal outputs are independent of each other. This instrument generates two separate A.F. Signals which can be used independently, one at a time, or both can be added for simultaneous use. It also generates four different, unmodulated I.F. signals which are available independently, one at a time, or in specific pairs simultaneously.

The instrument is enclosed in a combination case, as shown in Figure 1-1. The chassis may be removed from its case and mounted in a standard 19-inch equipment rack.

1-3. DESCRIPTION OF UNITS.

The instrument consists of the signal generator chassis, combination case and an 8-foot, 3-conductor power cable with plug and female connector attached.

1-4. REFERENCE DATA.

The following are the electrical characteristics of the instrument.

a. Frequency range.

(1) The frequency range of each of the two A.F. oscillators extends from 20 to 20,000 cps adjustable in increments of 1 cps from 20 to 100 cps and, in increments of 10 cps from 100 to 1000 cps, in increments of 100 cps from 1000 to 10,000 cps, and in increments of 200 cps from 10,000 to 20,000 cps.

(2) The I.F. signal generator provides signals as follows:

(a) 497.5 kc only.
(b) 498.5 kc only.
(c) 501.5 kc only.
(d) 502.5 kc only.
(e) 497.5 kc and 498.5 kc simultaneously (PR1).
(f) 501.5 kc and 502.5 kc simultaneously (PR2).

b. FREQUENCY CONTROL.

(1) A.F. oscillators employ a self-excited Wien bridge circuit.

(2) I.F. oscillators employ crystal control.

c. Types of emission.

(1) A.F. oscillators generate unmodulated sine wave signals.

(2) I.F. oscillators generate unmodulated sine wave signals.

d. OUTPUT LEVELS.

(1) A. F. signal output of 2 to 2. 5 volts and I. F. signal of 1 to 1. 25 volts can be attenuated up to 100db in increments of 1db and 10db and are intended to be fed into a 600 ohm (A. F.) or 50 ohm (I. F.) load.

e. Frequency accuracy over operating range.

(1) A.F. oscillator frequency accuracy is ±1% with a stability of 0.05% after 15 minutes warmup.

(2) I.F. oscillator frequency accuracy is ±0.01%.

f. DISTORTION.

(1) A.F. SIGNALS.

(a) Hum and noise are at least 60 db below maximum signal level.

(b) Intermodulation distortion is at least 60 db below maximum signal level.

(2) I.F. SIGNALS.

(a) Hum and noise are at least 60 db below maximum signal level.

(b) Intermodulation distortion is at least 60 db below maximum signal level.

g. AMBIENT TEMPERATURE LIMITATIONS.

(1) -28 C to +65°C.

h. POWER SUPPLY CHARACTERISTICS.

(1) 115 volts ± 10%, 47.5 to 450 cps, single phase.

(2) Input power is not in excess of 15 volt-amperes, continuous.

i. Heat dissipation.

(1) 12 watts.

j. Radiation hazard.

(1) None.

1-5. EQUIPMENT SUPPLIED.

The equipment supplied includes the Signal Generator Chassis, Combination Case, CA-301 Power Cable and Technical Manual.

1-6. PREPARATION FOR RESHIPMENT.

No special precautions are required in preparing this equipment for reshipment.

SECTION 2

INSTALLATION

2-1. UNPACKING AND HANDLING.

a. No special precautions are required.

2-2. POWER REQUIREMENTS.

a. The equipment is operable from a 115-volt (±10%), 47.5 to 450 cps, single phase power source. Power consumption is less than 15 watts.

2-3. INSTALLATION REQUIREMENTS.

a. The equipment may be operated in any position, but not when exposed to cold below -28°C or in excess of +65°C.

b. The equipment chassis may be removed from its case and mounted on a 19-inch equipment rack. Outline drawings are given in Figure 2-1.

2-4. CABLE ASSEMBLIES.

a. The power cable assembly (CA-301) is supplied with the equipment.

b. For connection to other equipment, the cable assemblies equipped with plugs designed to mate with a UG-625B/U connector are required.

2-5. INSPECTION AND ADJUSTMENT.

a. Check the mechanical operation of controls as below (see Figure 3-1). Failure of any of the controls to operate over their entire range is sufficient cause for failure of the instrument to pass this test.

(1) Remove the caps from the fuse holders, F301 and F302, and visually inspect the fuses. Replace fuses and caps.

(2) Operate the following toggle switches several times to both of their positions and leave them in the following positions.

(a) POWER switch, S305, to OFF.
(b) OUTPUT switch, S303, to A. F.
(c) 600Ω switch, S304, to Int.

(3) Operate the rotary switches to their clockwise and counterclockwise extremes and leave them in the following positions.

(a) CHANNEL A FREQUENCY CPS decade, S501, to 2.
(b) CHANNEL A FREQUENCY CPS units, S502, to 0.
(c) CHANNEL A FREQUENCY CPS multiplier, S503, to X10.
(d) CHANNEL B FREQUENCY CPS decade, S601, to 1.
(e) CHANNEL B FREQUENCY CPS units, S602, to 0.
(f) CHANNEL B FREQUENCY CPS multiplier, S603, to X10.
(g) CHANNEL SELECT, S301, to A.
(h) I.F. FREQUENCY KC, S302, to 497.5.

(4) Operate the potentiometers and attenuation controls to their clockwise and counterclockwise extremes and leave them in the following positions:

(a) I.F. BALANCE, R302, to mid-position.
(b) I.F. LEVEL, R303, to counter-clockwise.
(c) A.F. BALANCE, R301, to mid-position.
(d) ATTEN. DB, AT301, to 0.
(e) ATTEN. DB, AT302, to 0.

b. Check the electrical operation of the instrument as follows:

(1) Connect the power cable to J303 and a source of 115-volt, 60-cps power.

(2) Place POWER switch S305 to ON position.

(3) Note indicator lamp DS301. It should be energized immediately. If the lamp de-energizes at any time during subsequent tests, place POWER switch S305 to OFF position and discontinue tests until the cause of malfunction is determined and corrections made.

(4) Note METER M301. It should indicate 2 volts within a few seconds of turn-on.

(5) Adjust A.F. BALANCE, R301, and check for variation in meter reading.

(6) Set CHANNEL SELECT, S301, to B position.

(7) Reset A.F. BALANCE, R301, to mid-position.

(8) Note METER M301. It should indicate 2 volts.

(9) Adjust A.F. BALANCE, R301, and check for variation in meter reading.

(10) Set CHANNEL SELECT, S301, to A & B position.

(11) Note METER M301. It should indicate approximately 2.5 volts.

(12) Adjust A.F. BALANCE, R301. It should cause little or no effect on meter reading.

(13) Set CHANNEL SELECT, S301, to B position.

(14) Rotate CHANNEL B FREQUENCY CPS controls, (S601, S602, S603) throughout their entire ranges. Observe any positions at which meter indication changes greatly.

(15) Reset CHANNEL B FREQUENCY CPS controls (S601, S602, S603) to 1, 0 and X10 respectively.

(16) Set CHANNEL SELECT, S301, to A position.

(17) Rotate CHANNEL A FREQUENCY CPS controls (S501, S502, S503) throughout their entire ranges. Observe any positions at which meter indications change greatly.

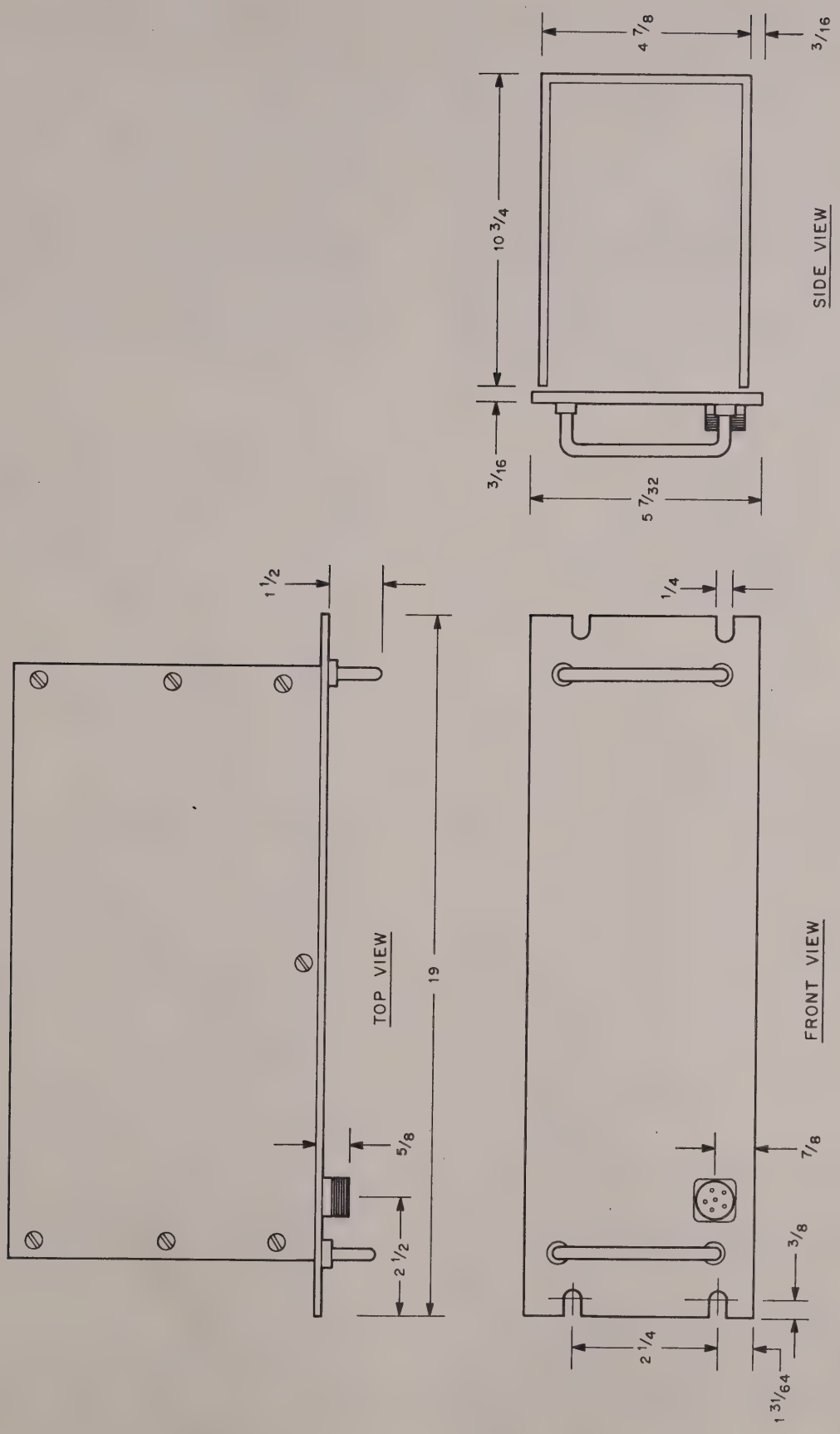


Figure 2-1. Signal Generator, SG-376A/U, Outline Drawing

(18) Reset CHANNEL A FREQUENCY CPS controls (S501, S502, S503) to 2, 0, X10 respectively.

(19) Set 600Ω switch, S304, to EXT. position. Meter indication should increase.

(20) Rotate ATTEN. DB, AT301 throughout its range. Meter indication should decrease at 10 DB and decrease further to 2 volts from 20 DB on up. Reset to 0 position.

(21) Rotate ATTEN. DB, AT302, throughout its range. Meter indication should decrease uniformly to about 2 volts.

(22) Reset 600Ω switch, S304, to INT. position.

(23) Set METER switch, S303, to I.F.

(24) Note METER M301. It should indicate greater than 1 volt.

(25) Operate I.F. FREQ. KC, S302, throughout its entire range. The meter indications at the various settings of the control should be approximately as follows:

(a) 1 volt at 497.5.
(b) 1 volt at 498.5.
(c) 1 volt at 501.5.
(d) 1 volt at 502.5.
(e) 1.25 volts at PR1.
(f) 1.25 volts at PR2.

(26) Set I.F. FREQ. KC, S302, to PR2 and rotate I.F. BALANCE, R302. Change in meter indication should be relatively small.

(27) Repeat step 26 with I.F. FREQ. KC, S302, set to PR1. Results should be the same as for step 26.

(28) Set I.F. FREQUENCY KC, S302 to 502.5 and rotate I.F. BALANCE, R302. Meter indication should vary.

(29) Repeat step 28 with I. F. FREQ. KC, S302, set to 501.5. Increase in meter indication should be obtained when I.F. BALANCE, R302, is rotated in opposite direction required in step 28 to increase meter indication.

(30) Repeat steps 28 and 29 with I.F. FREQ. KC, S302, set to 498.5 first, and then to 497.5. Results should be similar to those obtained in steps 28 and 29.

(31) Rotate I.F. LEVEL, R303, throughout its range. Meter indication should vary.

SECTION 3

OPERATION

3-1. FUNCTIONAL OPERATION.

This equipment generates single- and two-tone A.F. signals and single and dual I.F. signals for testing Single Sideband Communications Systems, Components, Assemblies, Modules and Spectrum Analyzers used for their maintenance. It performs the functions of two separate variable A.F. signal generators and two separate crystal-tuned I.F. signal generators.

3-2. APPLICATIONS.

The SG-376A/U audio two-tone generator, TS-1379/U spectrum analyzer, and a dummy load may be used to make precise measurements of intermodulation, carrier and sideband suppression, harmonics, spurious, noise and hum of SSB transmitters. The AN/URM-144/U R.F. two-tone generator, range extending converter, and the TS-1379/U spectrum analyzer† may be used to permit precise measurements of intermodulation, noise and hum of SSB receivers. These results are obtained by a spectrum analysis and display method wherein an equal amplitude two-tone excitation is applied to the system under test and an output response amplitude-versus-frequency plot is obtained on the CRT screen of a spectrum analyzer.

The degree of non-linearity of the SSB system under test is determined by intermodulation measurements made by use of the two-tone test signal-highly selective spectrum analysis method. In SSB intermodulation distortion tests, adjacent or in band odd order difference frequency distortion products are of major concern and, with present day military communications system design, only the 3rd or the 5th odd order product is of specific interest. The relatively distortion free signal generators, such as the SG-376A/U unit for audio and I. F. test function as the proper input test signal for the system under test. The spectrum analyzer receives and measures the system's output response to such an input. The TS-1379/U spectrum analyzer's sweep width of 30 Kc is used in the tuning and search of the system response. The remaining sweep width of 1, 2, 3.5, 7 and 14 Kc serve to provide the proper response display in accordance with the frequency separation value of the two-tone test signal being applied. The relationship of the intermodulation distortion product amplitude, to the main tone amplitude, gives an accorate indication of the relative level of distortion that has developed.

Both the SG-376A/U and the AN/URM-144/U signal generators are capable of generating one tone only, and a primary use of this single tone is to provide for hum modulation test. Any undesirable hum content within the SSB system under test will be developed as power line frequency sidebands disposed about the signal being applied. The resulting test response output is analyzed and displayed by the TS-1379/U Spectrum Analyzer. For 50 cps, and 60 cps power line frequency, the sweep width settings of 150 cps and 500 cps are used. Where power line frequency is 400 cps, use is made of 1000 cps and 2000 cps sweep width positions. Hum distortion response measurements are made in the same manner as for the intermodulation distortion determination.

3-3. PREPARATION FOR USE.

See Section 2.

3-4. OPERATING PROCEDURES.

a. DESCRIPTION OF CONTROLS.

(1) The controls and their functions are listed in table 3-1. The locations of the controls and indicators are illustrated in figure 3-1.

b. SEQUENCE OF OPERATION.

(1) The sequence of operation for generating A.F. signals is listed in table 3-2.

(2) The sequence of operation for generating I.F. signals is listed in table 3-2.

(3) The sequence of operation for generating A.F. and I.F. signals simultaneously is listed in table 3-2. Special notice: In an emergency, set POWER switch (S305) to OFF, disconnect output cables and P304 from power outlet.

c. INDICATOR PRESENTATIONS.

(1) Power ON indicator lamp (DS301).

(2) Output level meter (M301).

(a) Use as reference level for A.F. or I.F. signals. I.F. signal level should be greater than 1 volt, and A.F. signal level should be greater than 2 volts for normal operation.

d. TUNING ADJUSTMENTS.

(1) See tables 3-1 and 3-2.

3-5. SUMMARY OF OPERATING PROCEDURES.

a. SCOPE.

(1) SINGLE-TONE A.F. SIGNAL.

(a) Connect output cable from A.F. output (J301) to load.

(b) Set 600 Ω LOAD switch (S304) to INT. if load is significantly higher than 600 ohms.

(c) Set CHANNEL SELECT switch (S301) to A.

(d) Set POWER switch (S305) to ON.

(e) Select frequency with CHANNEL A FREQUENCY CPS switches (S501, S502 and S503).

(f) Set OUTPUT switch (S303) to A. F. and adjust A.F. BALANCE (R301) to obtain desired reference voltage level as indicated by the METER (M301).

†Refer to the appropriate TM for details of their operation.

TABLE 3-1. OPERATING CONTROLS

REFERENCE DESIGNATION	CONTROL	FUNCTION
S305	POWER	Power ON-OFF
S302	I.F. FREQ. KC	Select I.F. Frequency
R302	I.F. BALANCE	Balance output level of I.F. signals
R306, R307	I.F. LEVEL	Adjust I.F. Output Signal Level
S303	OUTPUT	Select output and monitor level
S301	CHAN SELECT	Select A.F. channel A, B or A + B
R301	A.F. BALANCE	Balance output level of A.F. signals
S304	600Ω LOAD	Connect or disconnect internal load to A.F. output
AT-301	ATTEN. DB	Adjust A. F. and I. F. output level in 10 db steps
AT-302	ATTEN. DB	Adjust A. F. and I. F. output level in 1 db steps.
S501	CHANNEL A FREQUENCY CPS	Select A.F. frequency in steps of 10 cps
S502		Select A.F. frequency in steps of 1 cps
S503		Multiply A.F. frequency X1, X10, X100 or X200
S601	CHANNEL B FREQUENCY CPS	Select A.F. frequency in steps of 10 cps
S602		Select A.F. frequency in steps of 1 cps
S603		Multiply A.F. frequency X1, X10, X100 or X200

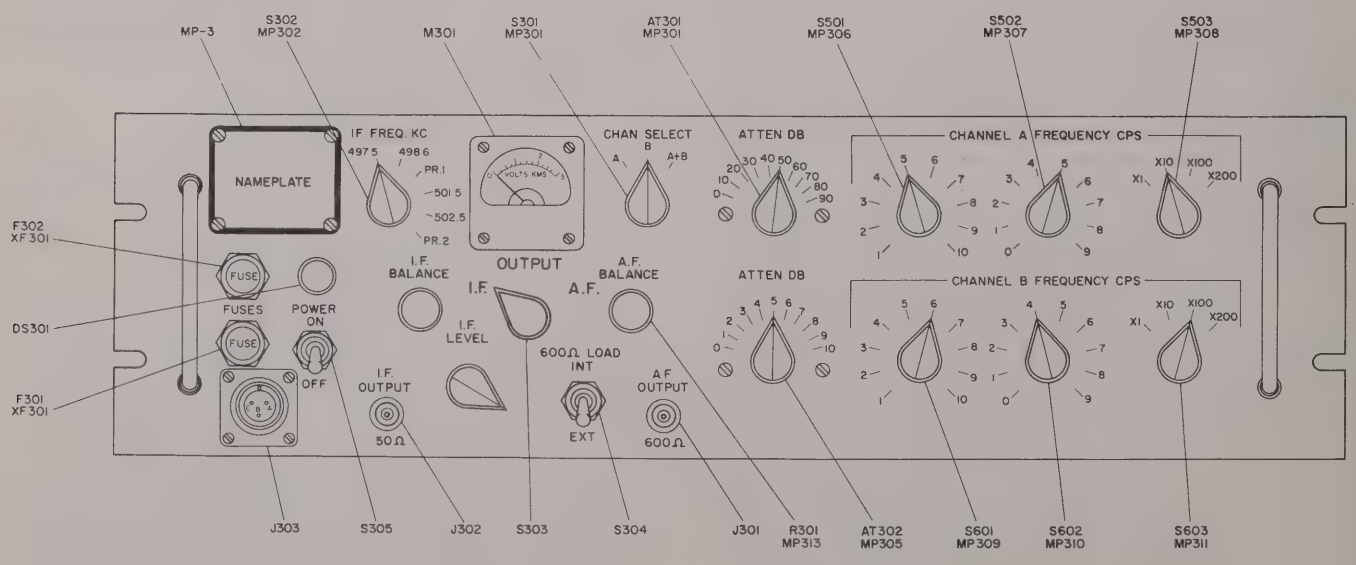


Figure 3-1. Signal Generator, SG-376A/U, Location of Operating Controls

TABLE 3-2. SEQUENCE OF OPERATION

CONTROL	REFERENCE DESIGNATION	CONTROL POSITIONS			
		ONE A.F. SIGNAL	TWO A.F. SIGNALS	ONE I.F. SIGNAL	TWO I.F. SIGNALS
POWER	S305	ON	ON	ON	ON
I.F. FREQ. KC	S302	Any	Any	Required freq.	PR1 or PR2
I.F. BALANCE	R302	Any	Any	Set to ref. level	Set to ref. level
I.F. LEVEL	R306, R307	Any	Any	As required	As required
OUTPUT	S303	A.F.	A.F.	I.F.	I.F.
CHAN. SELECT	S301	A or B	A + B	Any	Any
A.F. BALANCE	R301	Set to ref. level	Set to ref. level	Any	Any
600Ω LOAD	S304	Int	Int	Any	Any
ATTEN. DB	AT-301	As required	As required	As required	As required
ATTEN. DB	AT-302	As required	As required	As required	As required
CHANNEL A FREQUENCY CPS	S501	As required	As required	Any	Any
CHANNEL A FREQUENCY CPS	S502	As required	As required	Any	Any
CHANNEL A FREQUENCY CPS	S503	As required	As required	Any	Any
CHANNEL B FREQUENCY CPS	S601	As required	As required	Any	Any
CHANNEL B FREQUENCY CPS	S602	As required	As required	Any	Any
CHANNEL B FREQUENCY CPS	S603	As required	As required	Any	Any

(g) Adjust both ATTEN DB (AT-301 and AT-302) to reduce output signal to required level.

(2) TWO-TONE A.F. SIGNAL.

(a) Connect output cable from A.F. OUTPUT (J301) to load.

(b) Set 600Ω LOAD switch (S304) to EXT if load is 600 ohms, or to INT if load is significantly higher than 600 ohms.

(c) Set CHAN. SELECT switch (S301) to A + B.

(d) Set POWER switch (S305) to ON.

(e) Select frequencies with CHANNEL A FREQUENCY CPS switches (S501, S502 and S503) and CHANNEL B FREQUENCY CPS switches (S601, S602 and S603).

(f) With OUTPUT switch (S303) set to A.F., adjust A.F. BALANCE for minimum reading on the METER (M301).

(g) Note meter reading (reference level) and adjust ATTEN. DB (AT-301 and AT-302) to reduce output signal level as required.

(3) SINGLE I.F. SIGNAL.

(a) Connect output cable from I.F. OUTPUT (J302) to 50 ohm load.

(b) Set I.F. FREQ. KC (S302) to 497.5, 498.5, 501.5 or 502.5 as required.

(c) Set OUTPUT switch (S303) to I. F. and adjust I. F. LEVEL (R302) to obtain 1-volt indication or METER (M301)

(d) Adjust Atten DB (AT301 and AT302 to obtain required output signal level.

(4) DUAL I.F. SIGNAL.

(a) Connect output cable from I.F. OUTPUT (J302) to load.

(b) Set I.F. FREQ. KC to PR1 or PR2 as required.

(c) Set OUTPUT switch (S303) to I. F. and adjust I. F. BALANCE (R302) for minimum reading on METER (M301)

(d) Adjust I. F. LEVEL for 1-volt output for each of the two selected frequencies. Adjust ATTEN. DB (AT301 and AT302) to obtain required signal level.

3-6. OPERATOR'S MAINTENANCE.

a. OPERATING CHECKS AND ADJUSTMENTS.

(1) With OUTPUT switch (S303) set to A. F., CHAN. SELECT (S301) set to A, and A.F. BALANCE (R301) adjusted for 2-volt indication on the meter, rotate CHANNEL A FREQUENCY CPS switches (S501, S502 and S503) to all positions. Meter reading should not change significantly.

(2) With OUTPUT switch (S303) set to A. F., CHAN. SELECT (S301) set to B, and A.F. BALANCE (R301) adjusted for 2-volt indication on the meter, rotate CHANNEL B FREQUENCY CPS switches (S601, S602 and S603) throughout their ranges. Meter reading should not change significantly.

(3) Set CHAN. SELECT (S301) set to A + B, The meter indication should rise to approximately 2.5 volts.

(4) With OUTPUT switch (S303) set to I. F., I. F. FREQ. KC (S302) to 497. 5, adjust I. F. balance (R302) for mid position and I. F. level (R306, R307) cw. Then set I. F. FREQ. KC (S302) in sequence to 498. 5, 501. 5 and 502. 5. The meter reading should not drop below 1 volt.

(5) Repeat the above but with I.F. FREQ. KC (S302) set to PR1. The meter should now indicate a min. of 1. 25 volts. Then, set I. F. FREQ. KC to PR2. There should be little change in meter reading.

b. PREVENTIVE MAINTENANCE.

See Section 5.

c. EMERGENCY MAINTENANCE.

(1) If the equipment should fail to operate and POWER ON lamp DS301 fails to light, remove and replace fuse F301 and F302. In the event the new fuse blows, refer to Section 4.

SECTION 4

TROUBLE SHOOTING

4-1. LOGICAL TROUBLE SHOOTING.

a. SYMPTOM RECOGNITION. - The symptoms of faulty operation noted below can be recognized by observing the indicators, shown in figure 3-1, and are as follows:

(1) Failure of POWER ON INDICATOR lamp (DS301) to light, when the POWER switch (S305) is in the ON position, indicates absence of electric power, a blown FUSE (F301 or F302) defect in POWER CABLE ASSEMBLY (CA-301), defective POWER switch (S305) or burned out POWER ON INDICATOR lamp (DS301).

(2) Zero or very low indication by the METER (M301) when the POWER ON INDICATOR lamp (DS301) is lighted and with the OUTPUT switch (S303) in either IF or AF position indicates a failure in either the metering circuit or the power supply circuit.

(3) Zero or very low indication by the METER (M301) with the POWER ON INDICATOR lamp (DS301) lighted and only when the OUTPUT switch (S303) is in the I.F. position, and with the I.F. FREQ. KC switch (S302) set to any position, indicates that neither of the I.F. oscillators is functioning or that the METER switch (S303) is defective.

(4) Zero or very low indication by the METER (M301) with the POWER ON INDICATOR lamp (DS301) lighted and only when the OUTPUT switch (S303) is in the A.F. position and with the CHANNEL A FREQUENCY CPS switches (S501, S502, S503) and the CHANNEL B FREQUENCY CPS switches (S601, S602, S603) in any position, indicates that neither of the A.F. oscillators is functioning or that the meter circuit of OUTPUT switch (S303) is defective.

b. SYMPTOM ELABORATION. - The symptoms listed in table 4-1 can be recognized when using a vacuum tube voltmeter to measure the output signal levels.

c. PROBABLE FAULTY FUNCTIONS. - The Channel A and Channel B A.F. OSCILLATOR board assemblies (A7 and A8) and the I.F. OSCILLATOR board assembly (A6) share the same power supply simultaneously and the metering circuit alternately, as shown in block diagram figure 4-1. The following faulty conditions could occur:

(1) Absence of or very weak signals at both the A.F. OUTPUT jack (J301) and the I.F. OUTPUT jack (J302) because of failure of the power supply circuit. (Set output switch in desired position.)

TABLE 4-1. TROUBLE SHOOTING GUIDE

SYMPTOM	WHAT TO CHECK	HOW TO CHECK
DS301 not lighted.	AC line voltage. Fuses F301 and F302. DS301.	With meter or lamp at outlet. Try new fuses. Try new lamp.
No operation, DS301 lighted.	Voltage at emitter of transistor Q401.	With DC voltmeter.
No A.F. output at J301, meter indicates signal present.	Signal path through AT-301 and AT-302.	With oscilloscope.
No A.F. output at J301, meter indicates zero.	R301 and S301.	With ohmmeter.
No Channel A A.F. output.	Signal path through R301 and S301. A.F. Oscillator Assembly A7.	With oscilloscope.
No Channel B A.F. output.	Signal path through R301 and S301. A.F. Oscillator Assembly A8.	With oscilloscope.
No I.F. output at J302, meter indicates signal present.	Signal path through AT-301 and AT-302	With oscilloscope.
No. I.F. output at J302, meter indicates zero.	Transformers T1 and T2, T3	Try new transformers.
No. I.F. output on one frequency only.	Crystal Y1, Y2, Y3 or Y4.	Try new crystal.
No I.F. signal on 497.5 kc and 501.5 kc.	Tuning of L2.	Adjust L2.

TABLE 4-1. (Continued)

SYMPTOM	WHAT TO CHECK	HOW TO CHECK
No I.F. signal on 498.5 kc and 502.5 kc.	Tuning of L9.	Adjust L9.
Operation normal except meter indicates zero.	Meter circuit.	Trace signal path from arm of R301 to junction of C303 and C702 using oscilloscope or AC VTVM, with S303 set to A.F. Check DC voltage at + terminal of M301 with DC voltmeter.

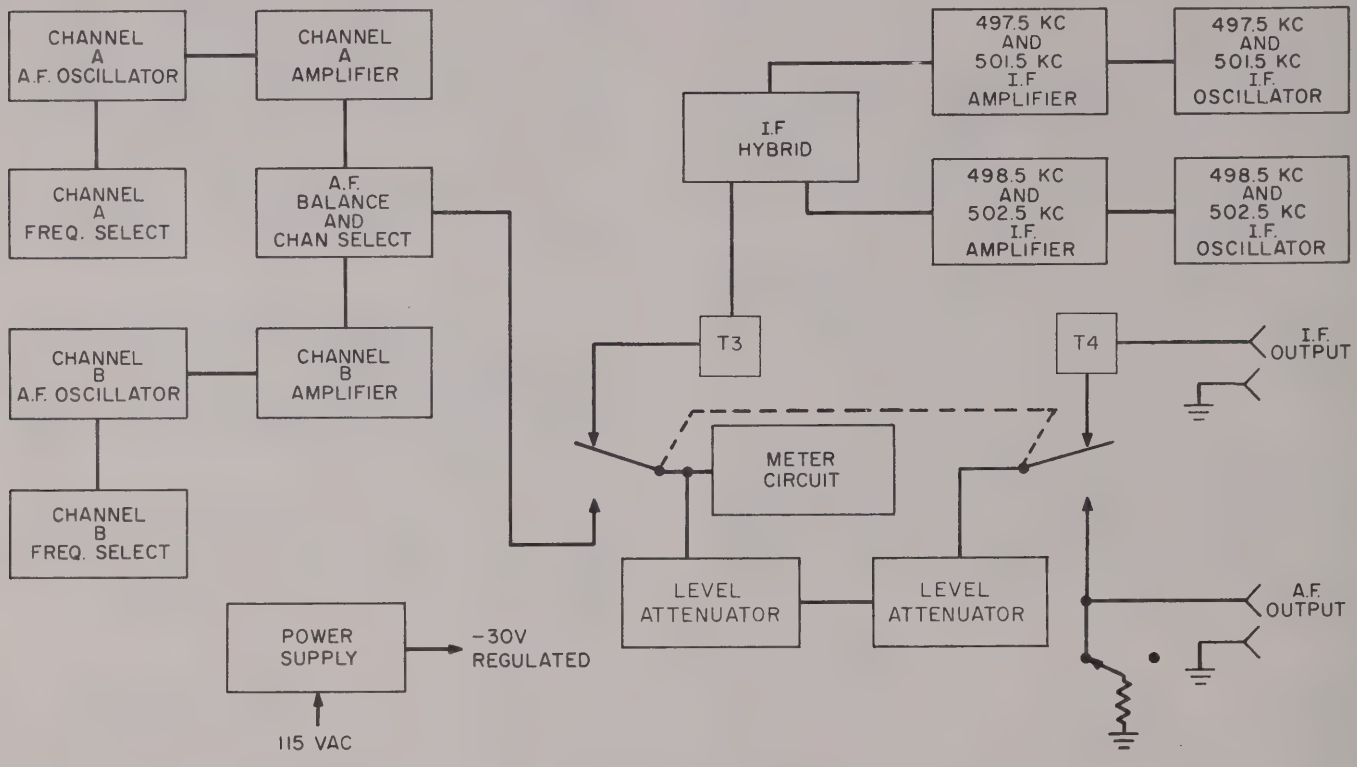


Figure 4-1. Signal Generator, SG-376A/U, Block Diagram

(2) Absence or distortion of, or a very weak signal of the I.F. OUTPUT jack (J302) with the I.F. FREQ. KC switch (S302) set to any position, but with normal signal present at the A.F. OUTPUT jack (J301) because of failure in the I.F. OSCILLATOR board assembly (A6) or defect in either DB control (AT-301, AT-302).

(3) Absence of, or off-frequency operation of, one of the four available I.F. signals at the I.F. OUTPUT jack (J302) because of a crystal failure.

(4) Absence of, or a very weak signal, at the A.F. OUTPUT jack (J301) with the CHAN SELECT switch (S301) set at A + B, but with normal signals present at I.F. OUTPUT jack (J302), because of a failure in the CHAN SELECT switch (S301), A.F. BALANCE control (R301) or either ATTEN DB control (AT301 or AT302).

(5) Absence of, or a very weak signal at the A.F. OUTPUT jack (J301) only when the CHAN SELECT switch (S301) is set at A, because of a failure in the Channel A A.F. OSCILLATOR board assembly (A7), CHAN SELECT switch (S301) or A.F. BALANCE control (R301).

(6) Absence of, or a very weak signal at the A.F. OUTPUT jack (J301) only when the CHAN SELECT switch (S301) is set at B, because of a failure in the Channel B A.F. OSCILLATOR board assembly (A8), CHAN SELECT switch (S301) or A.F. BALANCE control (R301).

(7) Distorted signal at the A.F. OUTPUT jack (J301), when CHAN SELECT switch (S301) is set to A, because of a defect in CHANNEL A A.F. OSCILLATOR board assembly (A7).

(8) Distorted signal at the A.F. OUTPUT jack (J301), when CHAN SELECT switch (S301) is set to B, because of a defect in CHANNEL B A.F. OSCILLATOR board assembly (A7).

(9) Off-frequency signal at the A.F. OUTPUT jack (J302) when CHAN SELECT switch (S301) is set to A, because of a defect in CHANNEL A NETWORK assembly (A501).

(10) Off-frequency signal at the A.F. OUTPUT jack (J301) when CHAN SELECT switch (S301) is set to B, because of a defect in CHANNEL B NETWORK assembly (A601).

d. LOCALIZING THE FAULTY FUNCTION. - The waveforms that can be observed with an oscilloscope at the various inter-assembly points are shown in figure 4-1. These waveform observations should be taken with the vertical input of the oscilloscope connected to the noted check points and the ground terminal of the oscilloscope connected to the chassis.

e. LOCALIZING TROUBLE TO THE CIRCUIT. - Malfunction due to defective components in or changes in characteristics of components can usually be localized by measurement of D.C. voltages and resistance. The electrical values of resistors and capacitors and the normal D.C. voltages at various circuit points, with respect to chassis ground, are indicated in the overall schematic diagram, figure 5-20.

(1) With electric power applied to the equipment, and using a vacuum tube voltmeter, such as the HP400D (Hewlett-Packard), set to measure negative D.C. volts and with its common lead connected to the equipment chassis, measure the voltage at the points on the suspected assembly as indicated in the schematic diagram in figure 5-20. The voltage at each point should be within ±10% of the value indicated on the drawing.

(2) With the equipment disconnected from the electric power source, measure the resistance of the resistors in the suspected assembly with a multimeter, such as AN/PSM-4 series or equivalent. Set the multimeter to measure ohms and connect the multimeter test leads directly across the leads of the resistors whose locations are indicated in Section 5. A variation of 20% from indicated resistance value may not necessarily be an indication of trouble except in the case of resistors in the FREQUENCY SELECT assemblies (A4 and A5) where an excessive change in resistance value could cause off-frequency operation of the applicable A.F. oscillator.

WARNING

Do not use a resistance measuring device which applies more than 1.5 volts to the circuit being measured in order to avoid damaging transistors or the meter (M301).

(3) If it is suspected that the trouble is in either transformer T1 or T2, as indicated by excessive intermodulation when I.F. FREQ. KC (S302) is set to PR1 or PR2, or when METER M301 indicates less than 1 volt when METER switch (S303) is in the I.F. position at any setting of I.F. FREQ. KC (S302), remove the transformers (T1 and T2) from their sockets and try new transformers of identical type. To test either or both of these identical transformers, measure the resistance across their terminal pins with a multimeter, set to measure ohms. The indicated resistances should be within 5% of the values given in figure 5-20.

(4) If the trouble is apparently in the power supply, measure the voltage across the secondary of transformer T401 with a vacuum tube voltmeter set to indicate A.C. volts. The meter should indicate 32 volts. Also, measure D.C. volts at the connector, base and emitter of transistor Q401, proceeding as in (1) above. The voltages should be as indicated in figure 5-20.

(5) If the trouble is apparently in the metering circuit, place the equipment into operating condition, set the OUTPUT switch (S303) to A. F. and measure the voltage at the center terminal (arm) of potentiometer R301, with respect to the chassis, using a vacuum tube voltmeter, set to measure 0-3 rms A.C. volts. Compare the indications of the vacuum tube voltmeter and Meter M301. Then, set the METER switch (S302) to I.F. and measure the voltage at the center terminal (arm) of R305, with respect to ground, using a vacuum tube voltmeter set to measure 0-3 rms A.C. volts. Compare the indications of the vacuum tube voltmeter and M301.

(6) When it is suspected that the trouble is in one or more of the transistors, the trouble can usually be detected when measuring operating voltages. A shorted or open transistor usually causes a sharp increase or decrease in voltage at one or more of its terminals. To actually test the transistors, remove them by unsoldering them from their respective assemblies and test them with a transistor tester.

WARNING

Do not remove transistors for testing unless necessary to do so. If necessary to disconnect transistors, use a small low-temperature soldering iron (35 watts or less), clasping each transistor lead with needle nose pliers to conduct heat away from the transistor while soldering or unsoldering.

f. FAILURE ANALYSIS. - A defect or a change in the characteristics of a component can produce the following effects:

(1) I.F. OSCILLATOR ASSEMBLY (A6).

(a) Resistor failure can cause non-operation, instability and output signal waveform distortion or change in amplitude by altering transistor voltage and current conditions.

(b) Capacitor failure can cause non-operation, oscillation instability and output signal waveform distortion or change in amplitude by altering signal path reactances.

(c) Inductance failure can cause non-operation and oscillation instability by altering signal path reactances, or, if open, non-operation can be caused.

(d) Transistor failure can cause non-operation.

(2) A.F. OSCILLATOR ASSEMBLIES (A7 AND A8).

(a) Resistor failure can cause non-operation, instability, waveform distortion and change in output signal amplitude by altering transistor voltage and current conditions and signal path resistance.

(b) Capacitor failure can cause non-operation, instability, waveform distortion and change in output signal amplitude by altering signal path reactances.

(c) Failure of lamp DS101 or DS102 can prevent oscillation.

Note

Lamps are operated at very low power and do not produce any light or heat during normal operation.

(d) Transistor failure can cause non-operation.

(3) NETWORK ASSEMBLIES (A500, A501, A600, A601)

(a) Resistor or capacitor failure can cause off-frequency operation and, when open, no oscillation at certain selected frequencies.

(4) POWER SUPPLY ASSEMBLIES (A11).

(a) Failure of resistor R402 can cause non-operation or change in output voltage.

(b) Capacitor failure can cause excessive ripple voltage, loss of output voltage or change in time constant of regulator.

(c) Transistor Q401, if open, will cause loss of output voltage and excessive voltage and hum if shorted.

(d) Failure of diode CR405 can cause non-operation or loss of voltage regulation.

(e) Failure of diode CR401, CR402, CR403 or CR404 can cause an increase in ripple voltage and/or reduction in output voltage.

(f) Failure of transformer T401 can cause loss of output voltage accompanied by excessive heating.

(5) METER BOARD ASSEMBLY (A9).

(a) Resistor failure can cause non-operation or erroneous meter indications.

(b) Capacitor failure can cause non-operation or erroneous meter indications.

(c) Failure of transistor Q701 can cause erroneous or absence of A.F. voltage indication on METER M301.

(d) Diode failure can cause erroneous or absence of meter indications.

(e) The meter, if open, can cause absence of signal indications, or, erroneous readings if shorted, grounded or physically damaged.

(6) CONTROLS.

(a) Switches can cause erratic or non-operation.

(b) Attenuators can cause noise in its output signal, erratic output signal level or loss of output signal.

(c) Balance potentiometers can cause inability to balance the levels of the output signals of their respective circuit assemblies.

4-2. OVERALL FUNCTIONAL DESCRIPTION.

a. The equipment generates two adjustable-frequency A.F. signals either or both of which are available at the A.F. OUTPUT jack (J301) and I.F. signals at four different frequencies which are available individually or in prescribed pairs at the I.F. OUTPUT jack (J302). Figure 4-1 is a block diagram showing the signal paths and output signal waveforms.

4-3. FUNCTIONAL SECTION DESCRIPTION.

a. OVERALL FUNCTIONAL SECTION DESCRIPTION.

The equipment is comprised of the following sections:

(1) I.F. oscillator board assembly (A6) and frequency selection switch (S302).

(2) Channel A A.F. oscillator board assembly (A7).

(3) Channel B A.F. oscillator board assembly (A8).

(4) Channel A A.F. network board assemblies (A500 and A501).

(5) Channel B A.F. network board assemblies (A600 and A601).

(6) Channel A frequency select assembly (A-5).

(7) Channel B frequency select assembly (A-6).

(8) Output switch assembly (S303) (A-10).

(9) Output attenuators (AT-301 and AT-302

(10) Power supply assembly (A-11).

(11) I.F. oscillator board assembly (TB-1).

b. A.F. OSCILLATORS AND FREQUENCY SELECTORS.

The two identical audio oscillators (Channels A and B) employ a Wien bridge oscillator circuit followed by an audio buffer amplifier consisting of a driver stage and an emitter follower output stage. Figure 4-2 is a simplified schematic of the oscillator circuit in which frequency sensitive components Ca-Ra and Cb-Rb form one arm of the bridge. The other arm is formed by R105 and DS101. The frequency of oscillation is determined by the resistances of Ra and Rb and the capacitances of Ca and Cb. The oscillator frequency can be changed by changing the resistances of Ra and Rb and/or the capacitances of Ca and Cb.

The oscillator employs a three-stage amplifier consisting of transistors Q101 and Q102 as common emitter amplifiers, each providing 180 degrees phase inversion, and Q103 as an emitter follower amplifier. The signal at the emitter of Q103 is fed back to the base of Q101 through Ca and Ra. Oscillation takes place when the signals at the emitter of Q103 and the base of Q101 are in phase. Another feedback path is through high frequency phase adjusting network C105 and R102 to the emitter of Q101 from the junction of R105 and tungsten lamp DS101 which divides the signal voltage between the emitter of Q103 and ground. Lamp DS101 is an essential part of the oscillator circuit and is not intended to function as an indicator.

In the actual instrument, as shown in the overall schematic diagram, figure 5-20, Ra and Rb consist of fixed resistors selected by S501 and S502, and Ca and Cb consist of fixed capacitors selected by S503. The oscillator frequency is adjustable from 10- to 100 units in 10-unit steps with S501 and is adjustable from 0 to 9 units in one unit steps with S502. With S503, the oscillator frequency is multiplied 1, 10, 100 or 200 times.

The output of the oscillator is fed from the emitter of Q103, as shown in figure 5-20, through C103 to the emitter of Q104. The signal at the collector of Q104 is fed directly to the base of Q105.

Feedback from the output to the base of Q104 is provided through R111. Forward bias on the base of Q104 is stabilized by diode CR101.

The output tone signal is derived at the junction of the emitter of Q105 and the collector of Q106 and fed through C104, S301A, R118 and R301 to J301 through attenuators AT-301 and AT-302. The output signal is also fed through R709 to the tone level metering circuit

The functioning of the Channel B audio oscillator is exactly the same as that of the Channel A audio oscillator.

c. CIRCUIT STAGE DESCRIPTIONS. (I. F. OSCILLATOR ASSEMBLY.)

The two I.F. oscillators employ identical circuits, differing only in operating frequencies as determined by their respective crystals. Each employs a crystal controlled oscillator and a push-pull buffer amplifier. Figure 4-3 is a simplified schematic of the oscillator stage which employs one transistor, Q1. Tank Coil L2 is resonated by series connected capacitors C1, C2, C3 and C4-C5. Variable trimmer capacitor C5, shunted across C4, permits adjustment of output signal balance.

Frequency is determined by crystal Y1 which permits maximum positive feedback at its resonant frequency. An RF choke, L1, provides a DC path to the power supply but isolates the signal end of L2 from ground at the operating frequency.

Signals at equal levels, but 180 degrees out of phase with each other are fed from the junction of C1 and C2 to the base of Q2, and from the junction of C3 and C4-C5 to the base of Q3, as shown in the overall schematic, figure 5-20. Transistors Q2 and Q3 are operated as emitter follower amplifiers. The output signals at their emitters, which are balanced with respect to ground, are fed to the primary winding of transformer T1.

The outputs of the two I.F. oscillator channels are summed in the hybrid circuit shown in the simplified schematic, figure 4-4. The output signals from Q2 and Q3 are fed to winding L1 of T1, and from Q5 and Q6 to winding L1 of T2. Transformers T1 and T2 form a hybrid circuit which prevents the signals across L1 of T1 from being fed into L1 of T2 and vice versa.

The L2 windings of T1 and T2 are connected in series-opposing through resistance Rm, which is a balancing network. The L3 windings of T1 and T2 are connected in series-aiding through the load impedance. The I.F. signals from both oscillator channels are therefore present at the output which is terminated in a fixed impedance load provided by attenuator AT-303.

Half of the power produced by the two oscillator channels is fed to the load and half is dissipated in R. When R is adjusted so that it reflects the same impedance as the load, the hybrid secondary currents are equal and opposing and feeding of signals from one oscillator channel to the other is minimized.

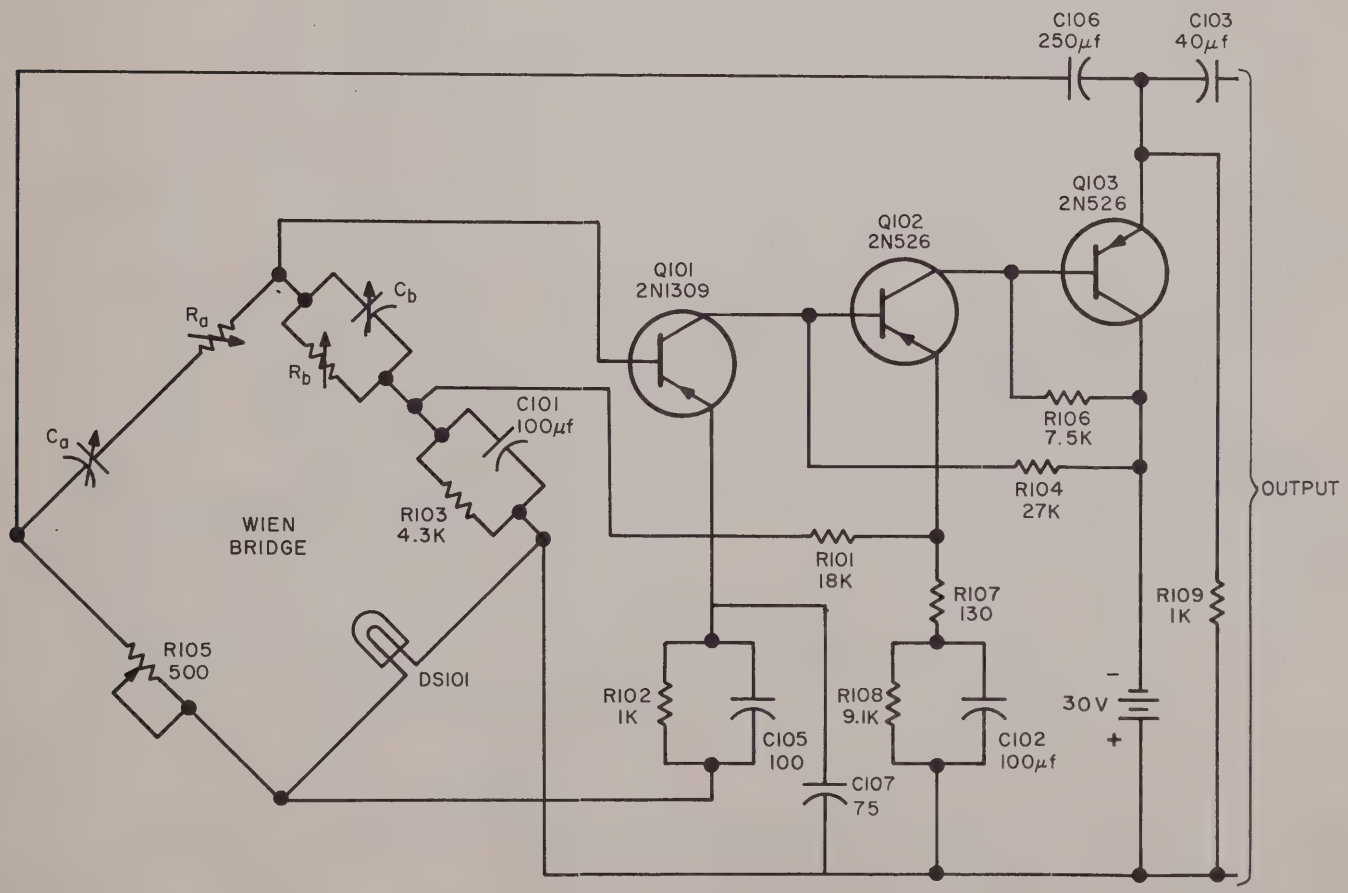


Figure 4-2. A.F. Oscillator, Simplified Schematic Diagram

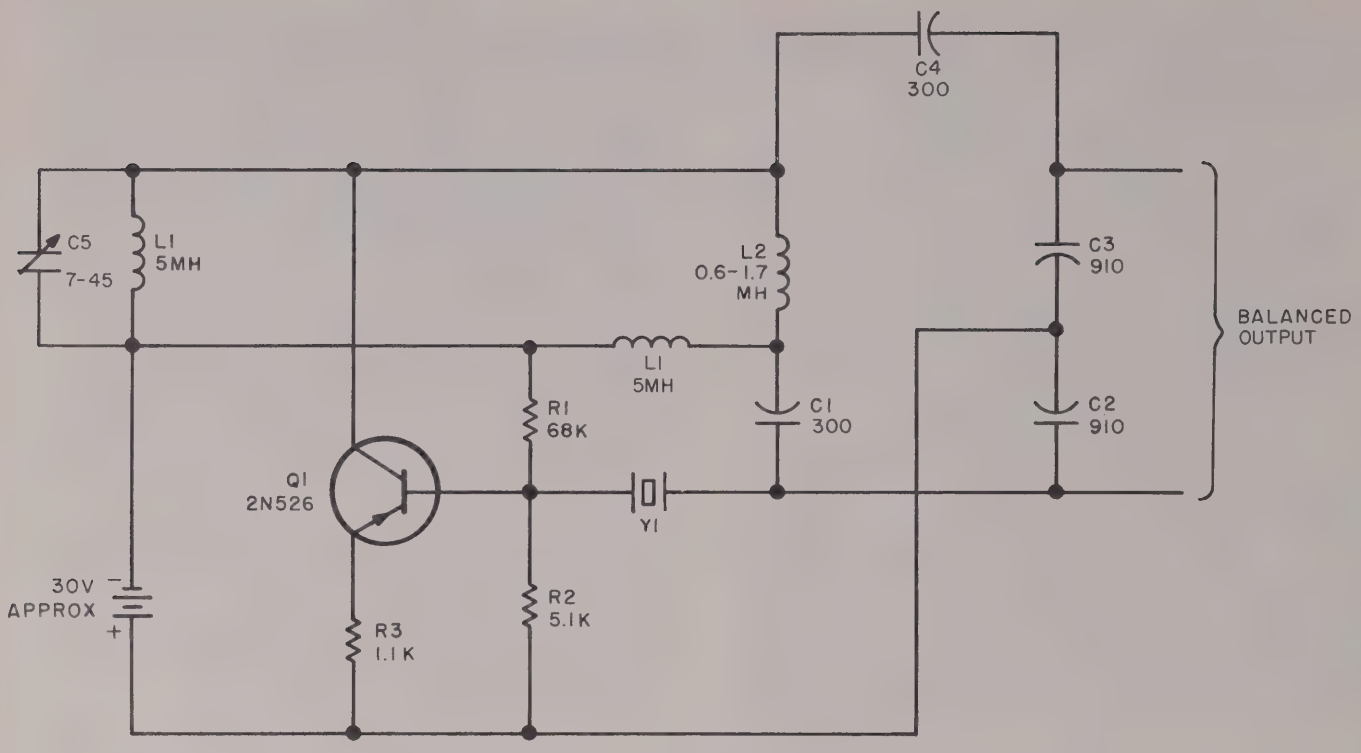


Figure 4-3. I.F. Oscillator, Simplified Schematic Diagram

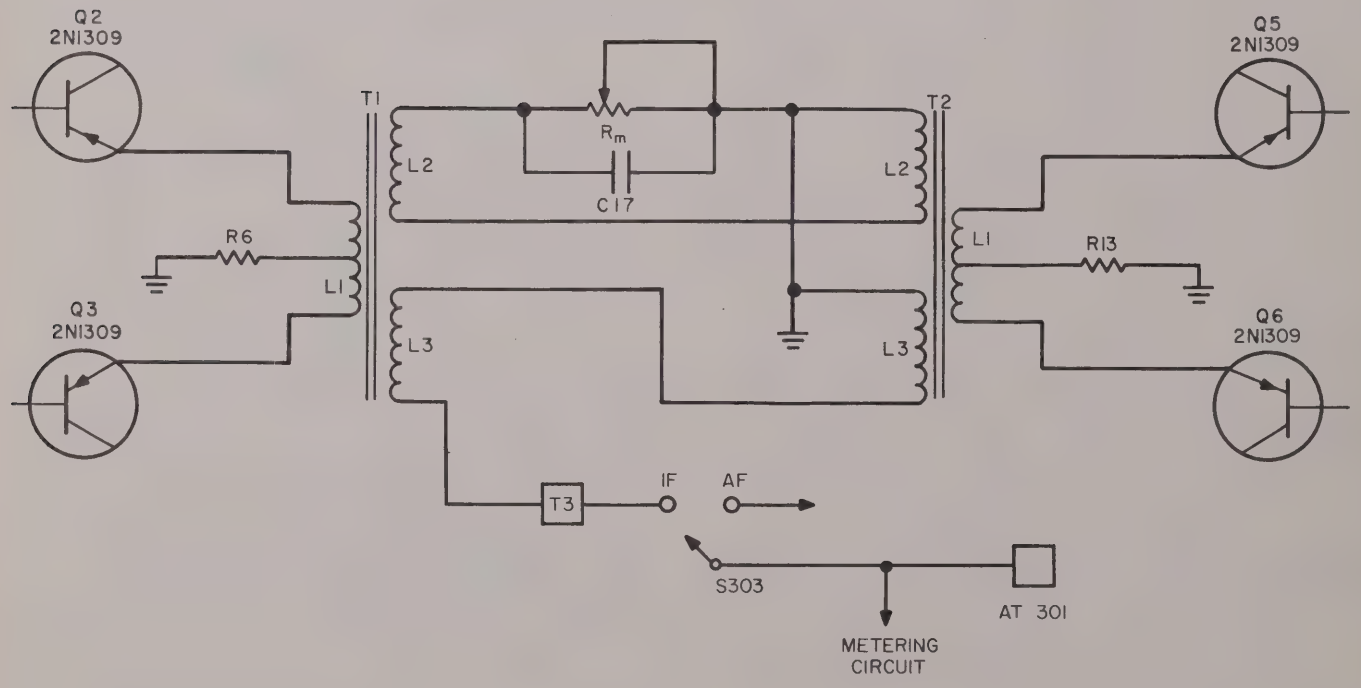


Figure 4-4. Hybrid Circuit, Simplified Schematic Diagram

In the actual instrument, as shown in figure 5-20, R consists of fixed resistors R8 and R9 plus potentiometer R7 which is used for balancing the hybrid circuit.

The operating frequencies of the two oscillator channels are selected by S302 which enables operation of 497.5 Kc, 498.5 Kc, 501.5 Kc or 502.5 Kc or simultaneously on 497.5 Kc and 498.5 Kc or 501.5 Kc and 502.5 Kc. The selected single signal or paired signal is fed through attenuator AT301 and AT302 to I. F. output jack J302 and to level metering circuit.

d. METERING CIRCUIT.

A single meter is used for indicating the level of either the tone signals or the I.F. signals. As shown in the simplified schematic, figure 4-5, the tone signal from AF balance control R301 is fed through OUTPUT switch S303, R709 and C704 to transistor Q701 which is operated as an emitter follower amplifier. Its output signal is fed through R305, R706 and CR702. The meter movement is drived by direct current obtained by rectification of the A. F. signal. Capacitors C705 and C701 cause the meter to measure peak-to peak voltage but is calibrated to indicate RMS voltage. Calibration of the meter is performed by adjusting R305 which functions as a multiplier resistor for the meter.

When S303 is in the I.F. position, the meter indicates RMS I.F. signal voltage level. The I.F. signal from the output of the I.F. oscillator channels is fed through S303, and follows the same path as the A. F. signal to CR701-2. Functioning is the same as for A.F. signal level indication except that variable trimmer capacitor C303 is used for meter calibration. It functions as a reactance shunted by the resistance of R708.

e. POWER SUPPLY.

The power supply employs a full-wave bridge rectifier and an emitter follower regulator, as shown in the simplified schematic diagram, figure 4-6. The supply voltage is reduced by transformer T401. The A.C. voltage from the secondary of T401 is rectified by CR401, CR402, CR403 and CR404 connected as a full-wave bridge rectifier. The positive DC output of the rectifier is grounded and the negative output is fed to the load through the variable resistance collector-emitter path through transistor Q401.

Transistor Q401 is an emitter follower. The base of Q401 is maintained at a constant voltage by the zener diode CR405. Because of the low output impedance of Q401 and the relatively constant load requirements of the generator the voltage at the emitter of Q401 is relative constant.

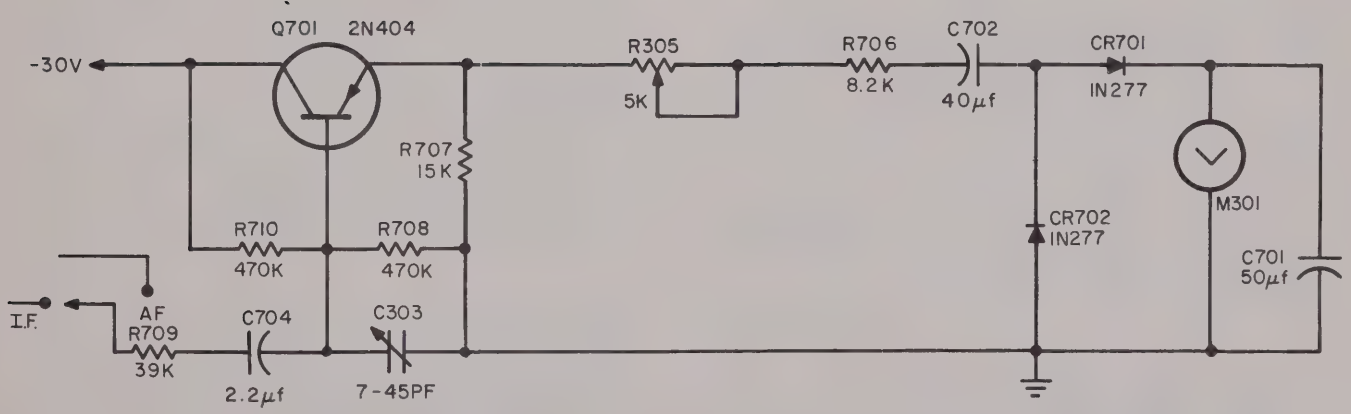


Figure 4-5. Meter Circuit, Simplified Schematic Diagram

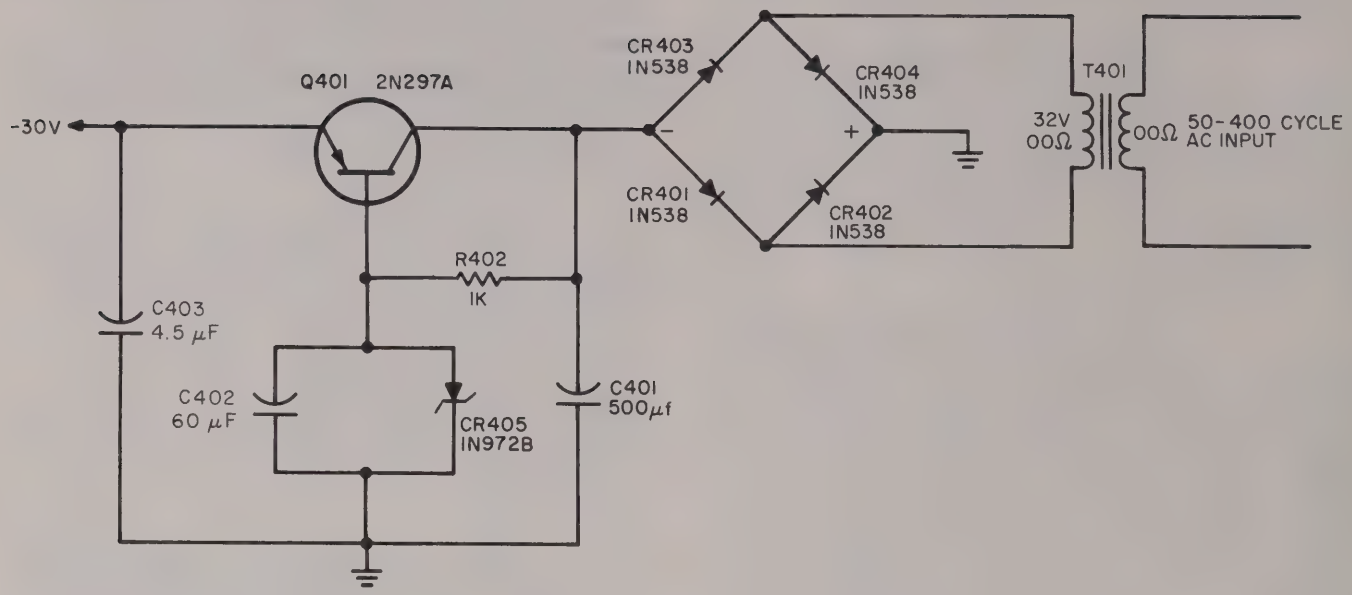


Figure 4-6. Power Supply, Simplified Schematic Diagram

SECTION 5

MAINTENANCE

5-1. FAILURE, AND PERFORMANCE AND OPERATIONAL REPORTS.

a. Naval Electronic Systems Command no longer requires the submission of failure reports for all equipment. Failure Reports and Performance and Operational Reports are to be accomplished for designated equipments (refer to Electronics Installation and Maintenance Book, NAVSHIPS 0967-000-0000) only to the extent required by existing directives. All failures shall be reported for those requirements for which Failure Reports are required.

5-2. PREVENTIVE MAINTENANCE.

a. MAINTENANCE STANDARDS. - The electrical test procedure shall be in accordance with performance specification of MIL-G-23532 (ships). Refer also to instruction manuals covering use of the test equipment listed below.

(1) TEST EQUIPMENT. - The following test equipment is required:

(a) Model 5244L Frequency Counter (Hewlett-Packard Co.).

(b) Model HP400D Vacuum Tube Voltmeter (Hewlett-Packard Co.).

(c) Model MD376 Spectrum Analyzer (Probescope Co., Inc.).

(d) 600 ohm ± 1% Audio Load resistor.

(e) 50 ohm ± 1% I. F. Load resistor.

(f) Model 200CD Signal Generator (Hewlett-Packard Co.).

(g) Model AT301 and AT302 Standard Attenuators (Probescope Co., Inc.).

(h) Model AA376 30 db Amplifier (Probescope Co. Inc.).

(2) FREQUENCY CALIBRATION ACCURACY. - Connect the equipments as shown in figure 5-1 and measure the frequency of the signal at A. F. OUTPUT jack, J301, with the Electronic Counter as prescribed below, recording the indicated results.

(a) With the Signal Generator controls set as specified in 2-5(a), (2), (3) and (4), adjust the Frequency Counter to indicate the frequency (200 cps) of the output signal.

(b) Rotate CHANNEL A FREQUENCY CPS units control (S502) throughout its range, one step at a time. Allow at least 3 counter periods when determining the frequency at each step. Return the control to the 0 position.

(c) Rotate CHANNEL A FREQUENCY SELECT multiplier, S503, to all four of its positions, one at a time. Reset control to the X200 position.

(d) Rotate CHANNEL A FREQUENCY SELECTOR CPS decade control, S501, throughout its entire range, one step at a time. Reset the control to the 2 position.

(e) Set CHAN. SELECT, S301, to the B position and CHANNEL B FREQUENCY CPS decade switch, S601, to the 2 position.

(f) Repeat steps (b), (c) and (d) using CHANNEL B FREQUENCY SELECTOR CPS controls S601, S602 and S603.

(g) Refer to Para. 3.4.3 and 3.4.4 of MIL-G-23532 (Ships), evaluate the test data for equipment passage or failure of this test, and summarize the results.

(h) Connect the equipments as shown in figure 5-2, and refer to Para. 3.6.2 and 3.6.4 of MIL-G-23532 (Ships).

(i) Set I. F. FREQ. KC, S302, to the 497.5 position, and adjust I. F. LEVEL, for satisfactory operation of the Electronic Counter. The counter should indicate 497.5 kc ± 100 cps.

(j) Set I. F. FREQ. KC, S302, to the 498.5 position. The counter should indicate 498.5 kc ± 100 cps.

(k) Set I. F. FREQ. KC, S302, to the 501.5 position. The counter should indicate 501.5 kc ± 100 cps.

(l) Set I. F. FREQ. KC, S302 to the 502.5 position. The counter should indicate 502.5 kc ± 100 cps.

(3) OUTPUT IMPEDANCE. - Refer to Para. 3.4.6 and 3.6.9 of MIL-G-23532 (Ships) and perform the following tests with the equipments connected as shown in figure 5-3.

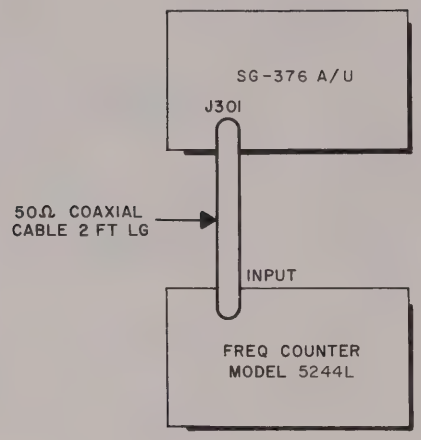


Figure 5-1. Set-up for A.F. Frequency Calibration Test, Connection Diagram.

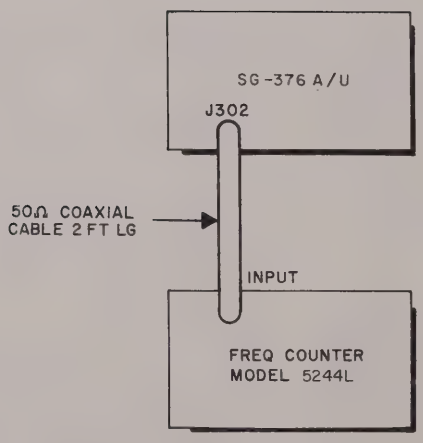


Figure 5-2. Set-up for I.F. Frequency Calibration Test, Connection Diagram

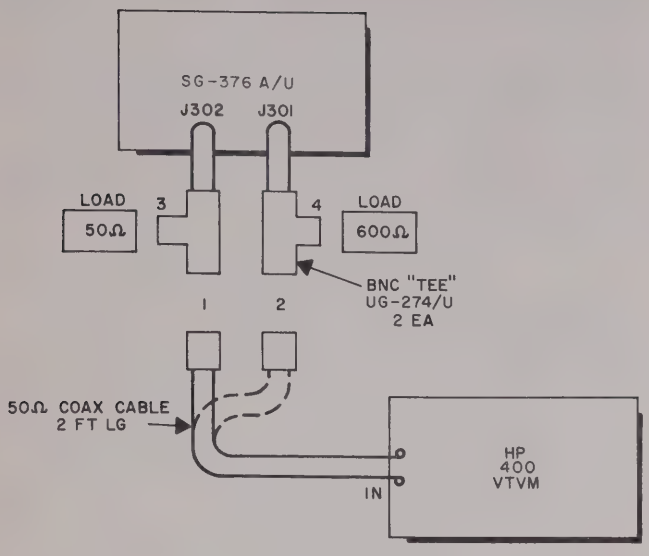


Figure 5-3. Set-up for Output Impedance Test, Connection Diagram

(a) Set 600Ω load switch, S304, to the EXT. position, ATTEN. DB, AT 301, to the 20 db position, and the vacuum tube voltmeter on the -10 db (0.3 volt) range. Adjust ATTEN DB, AT 302, and A.F. BALANCE, R301, to obtain a -6 db indication on the vacuum tube voltmeter.

(b) Disconnect the external 600-ohm load resistor, RL1, and observe the indication on the vacuum tube voltmeter, which should lie between -0.7 db and + 1.0 db.

(c) Readjust ATTEN. DB, AT 302, so that the vacuum tube voltmeter indicates 0 db. Set 600Ω load switch, S304, to the INT. position. The vacuum tube voltmeter, should now indicate within the -5.3 db to -7.0 db range.

(d) Connect the vacuum tube voltmeter to Tee connector T2 and adjust I.F. LEVEL, AT-303 for -6.0 db indication on the vacuum tube voltmeter.

(e) Remove the 50-ohm external load resistor, RL2, and observe the vacuum tube voltmeter indication, which should be within the -0.7 db and + 1.0 db range.

(f) Reset controls as they were at the beginning of this test.

(4) OUTPUT VOLTAGE. - Refer to Para. 3.4.7, 3.5.2 and 3.6.7 of MIL-G-23532 (Ships) and reconnect the equipments as shown previously in figure 5-4.

(a) Set 600Ω load switch, S304, to the INT. position. Set the vacuum tube voltmeter to the + 10 db (3 volt) range. Adjust A.F. BALANCE, R301, to obtain a 2-volt indication on the vacuum tube voltmeter.

(b) Set CHAN. SELECT, S301, to the B position. The vacuum tube voltmeter should indicate approximately 2 volts. Readjust A.F. BALANCE, R301, to obtain a 2-volt indication on the vacuum tube voltmeter.

(c) Set CHAN. SELECT, S301, to the A + B position. The vacuum tube voltmeter should indicate at least 2.5 volts.

(5) SPURIOUS OUTPUT. - Refer to Para. 3.5.1 and 3.6.6 of MIL-G-23532 (Ships). Disconnect all test equipment and connect the Spectrum Analyzers to the I.F. OUTPUT jack, J302, and the A.F. OUTPUT jack, J301, as shown in figure 5-5.

(a) Set the Center Frequency control of the MD-376 Analyzer to 500 kc. Set the Dispersion control for ± 5 kc dispersion.

(b) Following the instructions for the MD-376 Intermodulation Distortion Test, measure the intermodulation distortion with I.F. FREQ. KC, S302, set to PR2. In both cases, the intermodulation distortion should be at least -60 db.

(c) Remove the SG-376A/U Signal Generator from its combination case and pull crystals Y1, Y2, Y3 and Y4 out of their sockets, leaving them supported by the crystal holders.

(d) Connect the vacuum tube voltmeter to I.F. OUTPUT jack, J302, in place of the Spectrum Analyzer, and note the indication (hum and noise) on the vacuum tube voltmeter, which should be less than 1 millivolt.

(e) Reconnect the equipment as shown in figure 5-4. Set CHAN. SELECT, S301, to the A+B position. Set CHANNEL A FREQUENCY CPS controls S501 to 10, S502 to 0, and S503 to X200 to produce a 20 kc signal. Set CHANNEL BCPS controls S601 to 9, S602 to 0, and S503 to X200 to produce a 18 kc signal. Set both ATTEN. DB controls (AT-301 and AT-302) to 0 db.

(f) Following the instructions for the SS-20 Intermodulation Distortion Test, measure the intermodulation distortion of the A.F. output signal, which should be at least -60 db.

(g) Temporarily disable the Channel A and B A.F. oscillators by setting the frequency multiplier switches S503 and S603 between the normal detent positions.

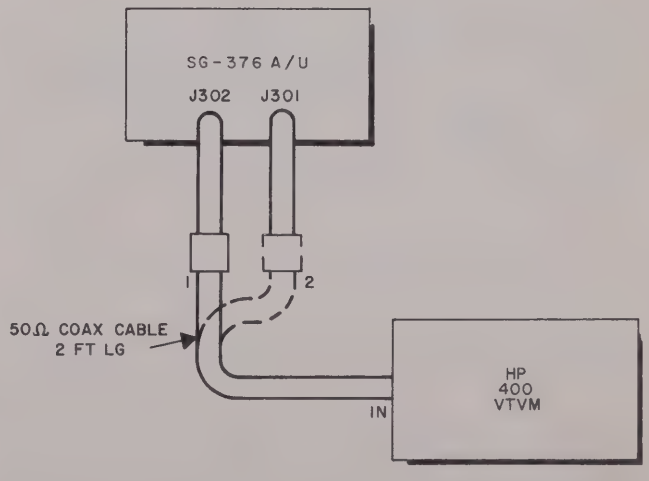


Figure 5-4. Set-up for Output Voltage Test, Connection Diagram

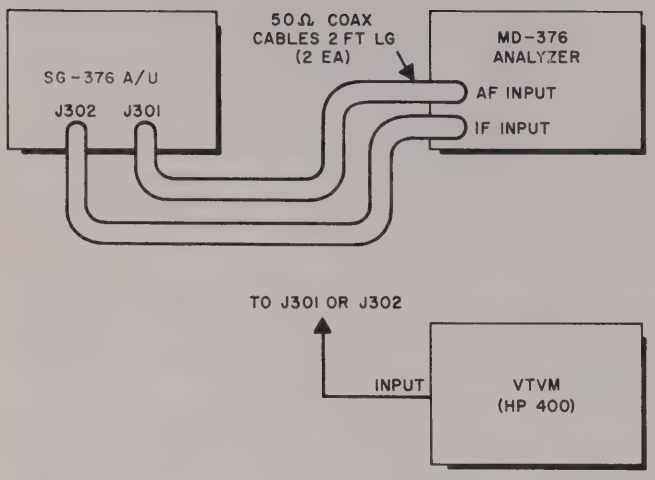


Figure 5-5. Set-up for Spurious Output Test, Connection Diagram

Note

Care is required to case these switches to "hang up" between normal positions.

(h) Connect the vacuum tube voltmeter to A.F. OUTPUT jack, J301, in place of the SS-20 Spectrum Analyzers and note its voltage indication which should be less than 2 millivolts.

(i) Reset frequency multiplier switches S503 and S603 to their X10 positions.

(6) OUTPUT ATTENUATOR RANGE AND ACCURACY. - Refer to Para. 3.5.3 and 3.5.4 of MIL-G-23532 (Ships).

(a) With the SG-376A/U Signal Generator out of its combination case, and POWER switch S305 in the OFF position, remove the jumper from Test Point 1. Insert lead "A" into the attenuator side of Test Point 1, as shown in figure 5-6, and connect the equipments as shown in the same diagram.

(b) Set ATTEN. DB controls AT-301 and AT-302 to their O positions. Adjust the standard attenuators to their indicated 100 db settings.

(c) Set the frequency of the external Audio Frequency Generator to 1000 cps and its output level to produce an indication of 0 db on the vacuum tube voltmeter when its range switch is set to the 1-millivolt full scale position.

(d) Set ATTEN. DB, AT-302, to the 1 db position and reduce the attenuation of the standard 1 db-per-step attenuator by 1 db. The indication of the vacuum tube voltmeter should change, but not more than 0.5 db. Repeat this procedure for all steps of ATTEN. DB AT-302.

(e) Repeat step (d), above, for ATTEN. DB AT-301 and using the 10 db-per-step standard attenuator. The attenuation increments are now 10 db but the maximum change allowed in vacuum tube voltmeter indication is still 0.5 db or less.

(f) Disassemble the attenuator test set-up and restore the SG-376A/U Signal Generator to normal operation.

(7) PREVENTIVE MAINTENANCE PROCEDURES. - The following preventive maintenace should be performed every 90 days.

(a) Make visual inspection and check mechanical operation of controls as described in section 2, para. 2-5.

(b) Perform electrical tests as described in this section and as listed in table 5-1.

b. TUNING AND ADJUSTMENT.

(1) TEST EQUIPMENT. - The following test equipment is required.

(a) Two Model HP400D Vacuum Tube Voltmeters (Hewlett-Packard).

(b) Two low capacity probes for above vacuum tube voltmeter.

(c) Model MD376 Spectrum Analyzer (Probescope Co. Inc.).

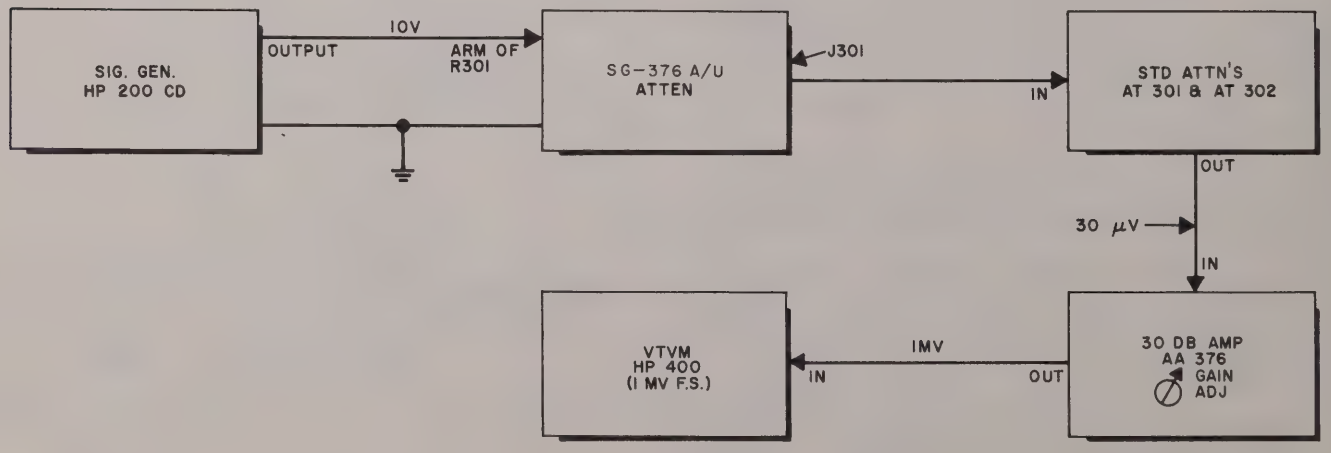


Figure 5-6. Set-up for Attenuator Test, Connection Diagram

TABLE 5-1. REFERENCE STANDARDS PROCEDURES

The procedures listed below consist of the minimum number of reference standards which will indicate, when completed, the relative performance of the SG-376A/U Signal Generator. The procedures are listed in the suggested sequence of performance. However, deviation from the listed order will in no way affect the unity or result of the reference standards.

FUNCTION	ACTION REQUIRED
A.F. output level	Measure output level at J301 (2.0 volts min.)
A.F. frequency calibration	Measure frequency at J301 (20 cps to 20 KC)
A.F. intermodulation	Measure intermodulation at J301 (below 60 db)
I.F. output level	Measure output level at J302 (1.0 volt min.)
I.F. frequency calibration	Measure frequency at J302 (as applicable)
I.F. intermodulation	Measure intermodulation at J302 (below 60 db)
Hum level	Measure hum level at J301 (below 60 db) Measure hum level at J302 (below 60 db)

TABLE 5-2. PREVENTIVE MAINTENANCE PROCEDURES

WHAT TO CHECK	HOW TO CHECK	CORRECT RESULT
A.F. output	Set S301 to CHAN. A and observe indication on meter M301 with S501, S502 and S503 in all positions. Set S301 to CHAN. B and observe indication on meter M301 with S601, S602 and S603 in all positions.	Meter (M301) indication should not vary. Meter (M301) indication should not vary.
I.F. output	Set S302 to 497.5, and 501.5 and observe indication on meter M301. Set S302 to 498.5, and 502.5 and observe indication on meter M301.	Meter (M301) should indicate at least 1 volt.
Controls	Operate all controls through all positions.	Positive action.
Chassis and combination case cleanliness	Remove dust with dust brush and cloth or blow out dust with dry compressed air.	
Mechanical	Tighten all loose screws.	
Visual	Power transformer for impregnant leak. Resistors for discoloration. Capacitors for bulging of cases.	

(2) PRELIMINARY PROCEDURE. - Remove Signal Generator from combination case and connect power cable CA-301 to J303 and source of 115-volt, 60-cps power.

(3) CONTROL SETTINGS. - Set all controls as specified in Section 2 under 2-5a (2), (3) and (4).

(4) I.F. OSCILLATOR ADJUSTMENT.

(a) Set METER switch (S303) to I.F. position.

(b) Connect 50-ohm resistor and vacuum tube voltmeter to I.F. OUTPUT jack (J302) and set VTVM to 0-3 A.C. volts range.

(c) Rotate I.F. LEVEL (AT-303) to full clockwise position.

(d) Set POWER switch (S305) to ON position.

(e) After three minutes of operation, rotate I.F. FREQ. KC (S302) through all of its positions and observe indications of the vacuum tube voltmeter. It should indicate at least 1 volt on all settings of S302 except PR1 and PR2. At the PR1 and PR2 setting, the meter should indicate at least 1.25 volts or more.

(f) If there is a difference in voltage readings when S302 is switched to 497.5 and 501.5, adjust the slug of coil L2 on the I.F. Oscillator board assembly (A6) so that the meter indications obtained at both of these settings of S302 are identical.

(g) Repeat above step for 498.5 and 502.5 settings of S302, but adjust slug of coil L9 to obtain equal voltage readings at both of these settings of S302.

(h) Disconnect vacuum tube voltmeter from J302. Leave 50-ohm resistor connected across J302.

(i) Attach a low-capacity probe to each of the two vacuum tube voltmeters. With a clip lead, ground the vacuum tube voltmeter case to the signal generator chassis.

(j) Connect one low-capacity probe to the exposed lead of L4 (on I.F. oscillator board assembly A-6) which is connected internally to the base of transistor Q3. Connect the other probe to the exposed lead of L3 which is connected internally to the base of transistor Q2.

(k) Set S302 to 497.5.

(l) Set both vacuum tube voltmeters to the same A.C. volts ranges (select range which gives maximum reading without pinning meter needle). Adjust C5 until indications of both meters are identical. Set S302 to 501.5 and readjust C5, if necessary, to obtain identical meter reading.

(m) Repeat above but with probes connected to leads of L7 and L8 (connected internally to the bases of Q6 and Q5 respectively). Set S302 to 498.5 and adjust C12 so that both meters indicate same voltage. Set S302 to 502.5 and readjust C12, if necessary, to obtain identical meter readings.

(n) Connect the MD 376 Analyzer to the I.F. OUTPUT jack, J302, and rotate the I.F. FREQUENCY kc control (S302) to the PR1 position.

(o) Set each frequency of the pair to a 1-volt level by using the LEVEL and BALANCE control.

(p) If the IMD products are of equal amplitude and are not 60 db below the PR1 levels, adjust R7 to reduce the level of the products.

(q) Rotate the I.F. FREQUENCY kc control (S302) to the PR2 position and repeat steps (o) and (p) above for the PR2 products. A compromise adjustment of R7 may be necessary to minimize the IMD product levels for both PR1 and PR2.

Note

Provision is made for insertion of a capacitor (C17) between T1 and T2 to reduce IMD below 70 db if desired. C17 value will be approximately 200 pfd.

(r) If the IMD products are of unequal amplitude and adjustment of R7 cannot reduce the distortion levels 60 db below either the PR1 or PR2 levels, adjust C5 or C12 for minimum IMD products as illustrated below.

Note

The adjustment of either capacitor affects the amplitude of the two frequencies associated with it (497.5 and 501.5 kc for C5 and 498.5 and 502.5 kc for C12). Care must be taken to maintain the required output voltage levels and balance. Readjustment of L2 may be necessary if C5 is adjusted and L9 if C12 is adjusted. (See figure 5-7.)

(5) A.F. OSCILLATOR ADJUSTMENT. - None required.

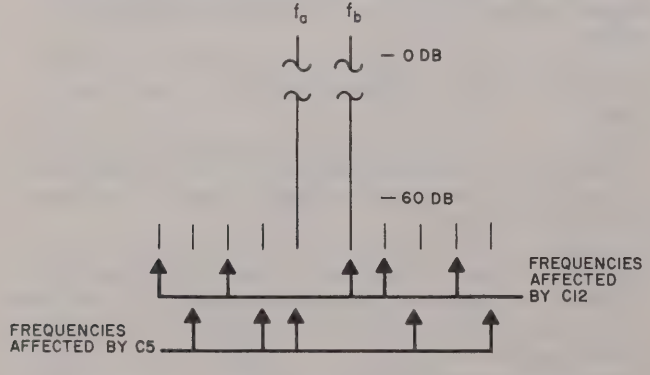


Figure 5-7. Effects of C5 and C12 Adjustment

(6) METER CALIBRATION ADJUSTMENT.

(a) Set OUTPUT switch (S303) to A. F. position.

(b) Connect vacuum tube voltmeter to A.F. OUTPUT jack (J301) and set it to 0-3 A.C. volts range. Leave 600Ω load switch (S304) at INT. position.

(c) Set POWER switch (S305) to ON position. Set ATTEN. DB controls (AT-301, AT-302) to their O positions.

(d) Set CHANNEL A FREQUENCY CPS switches (S501, S502, S503) to their 10, 0 and X10 positions respectively.

(e) With CHAN. SELECT switch (S301) in A position, adjust A.F. BALANCE R301 to obtain 2-volt indication on vacuum tube voltmeter.

(f) Adjust R305 until METER M301 also indicates 2 volts.

(g) Disconnect vacuum tube voltmeter from J301, connect it to I.F. OUTPUT jack (J302) and leave it set at 0-3 A.C. volts range. Also connect a 50-ohm resistor across J302. Set I.F. LEVEL (AT-303) to full clockwise position. Set METER switch S303 to I.F. position.

(h) Set I. F. FREQ. KC (S302) to 497.5 and adjust I. F. LEVEL to obtain 1-volt indication on vacuum tube voltmeter. Adjust C303 to obtain 1-volt indication on METER M301.

5-3. REPAIR.

a. REMOVAL REPAIR AND REPLACEMENT OF ASSEMBLIES AND PARTS. - The locations of the circuit board assemblies, operating controls, indicators, fuses and jacks and top of chassis components, as viewed from above, are shown in figure 5-9. The locations of the components under the chassis are shown in figure 5-10. The locations of the components of the various circuit boards are shown in figures 5-11 through 5-19. No special methods or procedures are required for removal, repair and replacement of assemblies and parts except as follows:

(1) REMOVAL

(a) Unsolder, but only when necessary, any component attached to the circuit board assemblies.

WARNING

Avoid damage to transistors and other components by using a low-wattage soldering iron (35 watts or less).

(b) To remove transformer T1 or transformer T2, pull it out of its socket.

(c) To remove crystals Y1, Y2, Y3 and/or Y4, pull it out of its socket.

(2) REPAIR

(a) Test Equipment. - The following test equipment is required.

(1) A multimeter such as AN/PSM-4 series or equal.

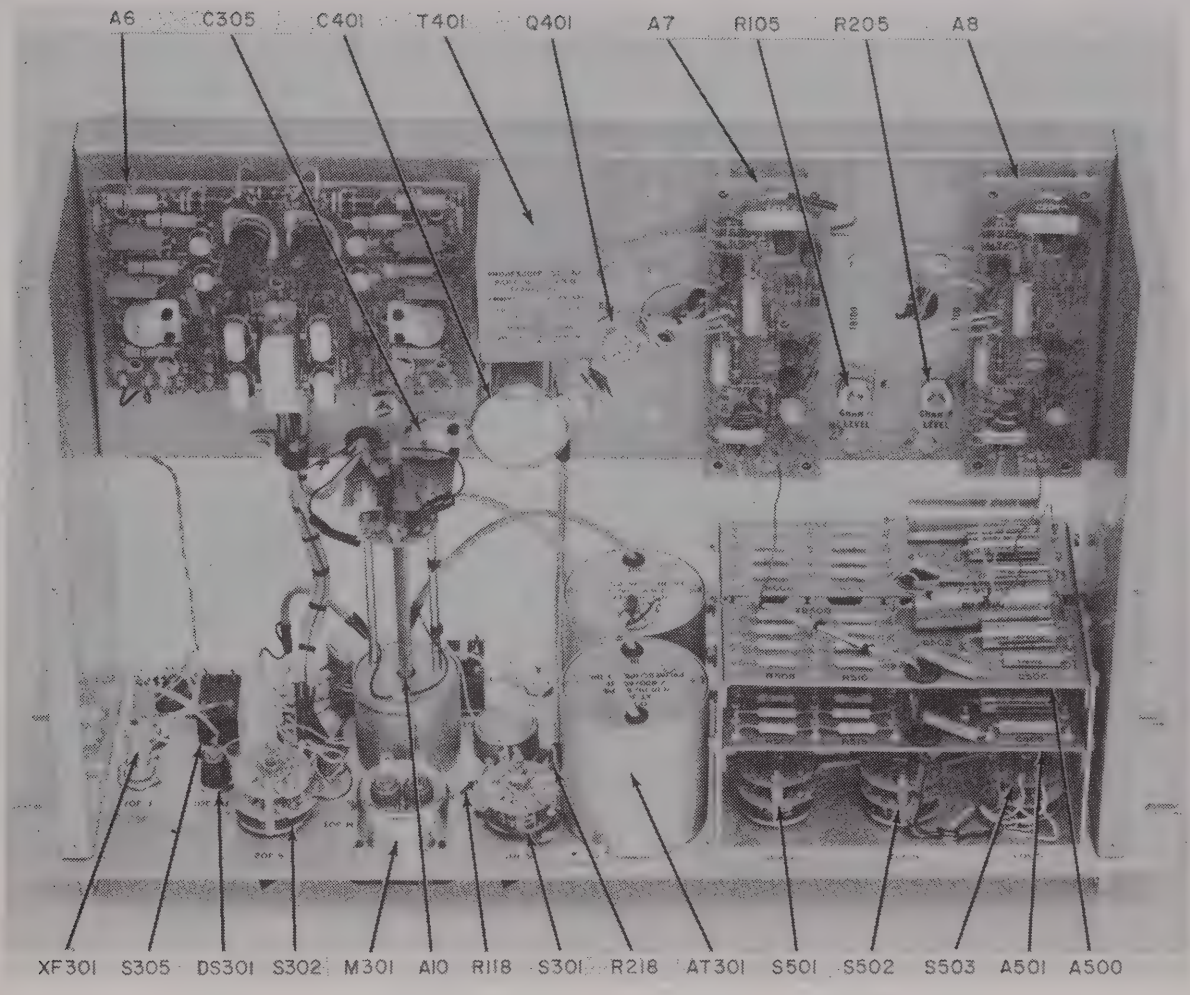


Figure 5-8. Signal Generator, SG-376A/U, Top of Chassis

(2) An electronic counter Model 14-20 (Northeastern Engineering).

(3) An oscilloscope such as Tektronix Model 545.

(4) I. F. and Audio Spectrum Analyzers such as Probescope Co. Inc., Model MD500E and SS20.

(b) Instructions. - No special procedures are required for testing the components in this equipment.

(3) REPLACEMENT. - No special instructions are required for replacement of components except as follows:

(a) Resistors and capacitors contained in the Channel A (A500, A501) and Channel B (A600, A601) NETWORK board assemblies must be replaced only with identical components of the same accuracy tolerance in order to avoid frequency error.

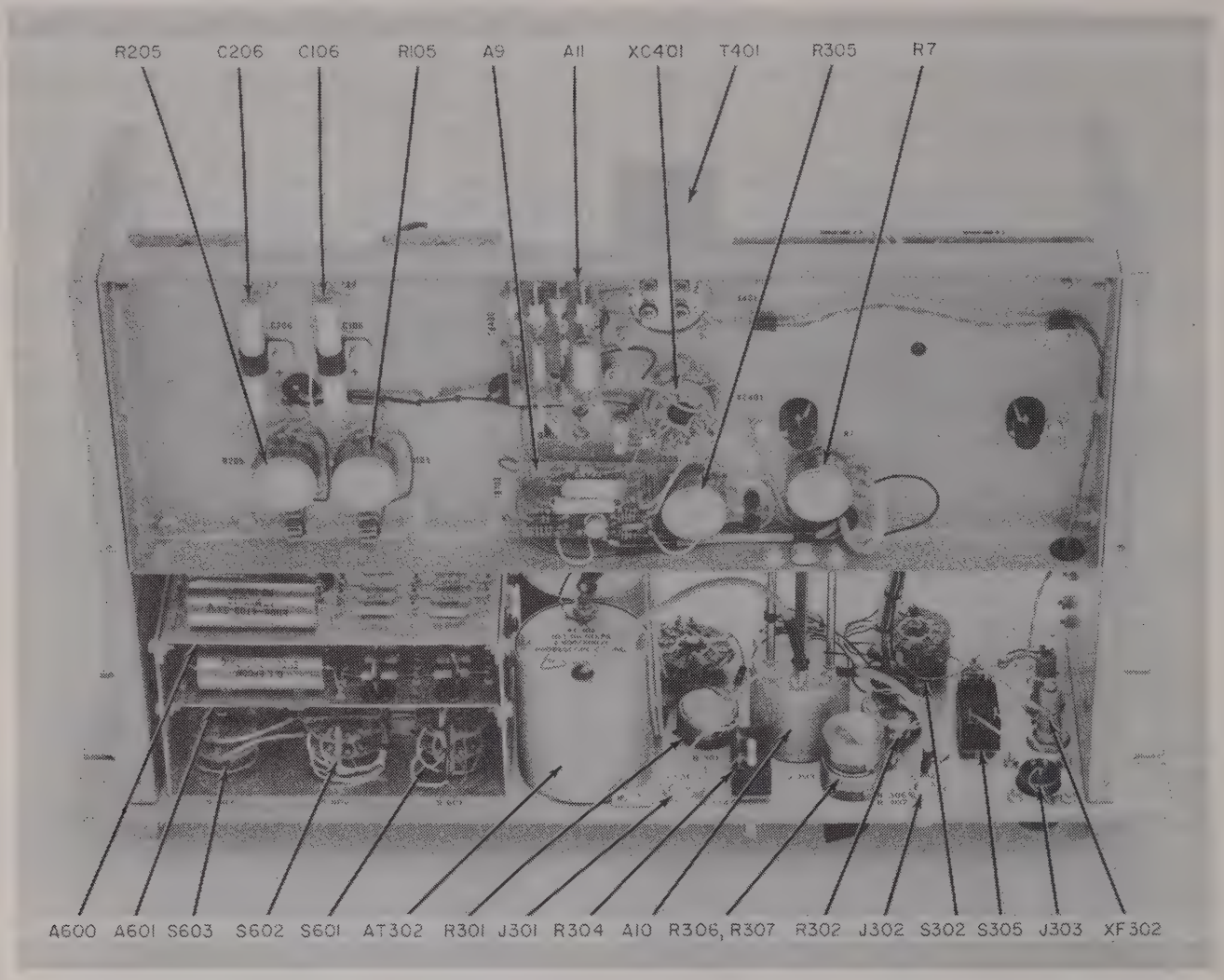


Figure 5-9. Signal Generator, SG-376A/U, Bottom of Chassis

5-4. ILLUSTRATIONS.

a. PART LOCATION ILLUSTRATIONS. - The locations of parts and printed circuit boards are shown and called out in the following illustrations:

(1) Front view of operating controls, indicators and jacks, figure 3-1.

(2) Top view of operating controls, indicators, jacks, printed-circuit boards and chassis, figure 5-9.

(3) Bottom view of chassis, figure 5-10.

(4) I. F. OSCILLATOR board, figure 5-11.

(5) Channel A A. F. OSCILLATOR board, figure 5-12.

(6) Channel B A. F. OSCILLATOR board, figure 5-13.

(7) Channel A NETWORK assemblies, figures 5-14 and 5-15.

(8) Channel B NETWORK assembly, figures 5-16 and 5-17.

(9) Power supply board assembly, figure 5-18.

(10) Meter board assembly, figure 5-19.

b. SCHEMATIC DIAGRAM. - Figure 5-20 is an overall schematic diagram of the equipment. The major signal paths are indicated by heavy lines and the direction of signal flow by arrows.

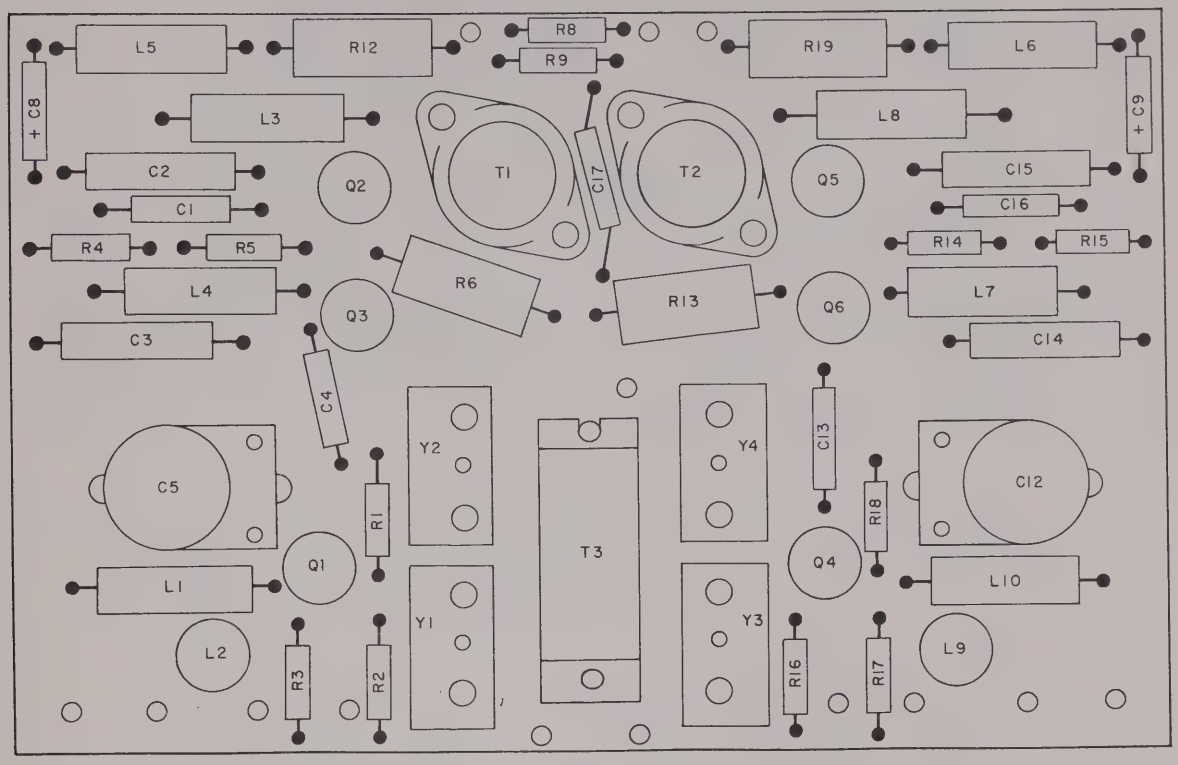


Figure 5-10. I.F. Oscillator Board Assembly, Location of Components

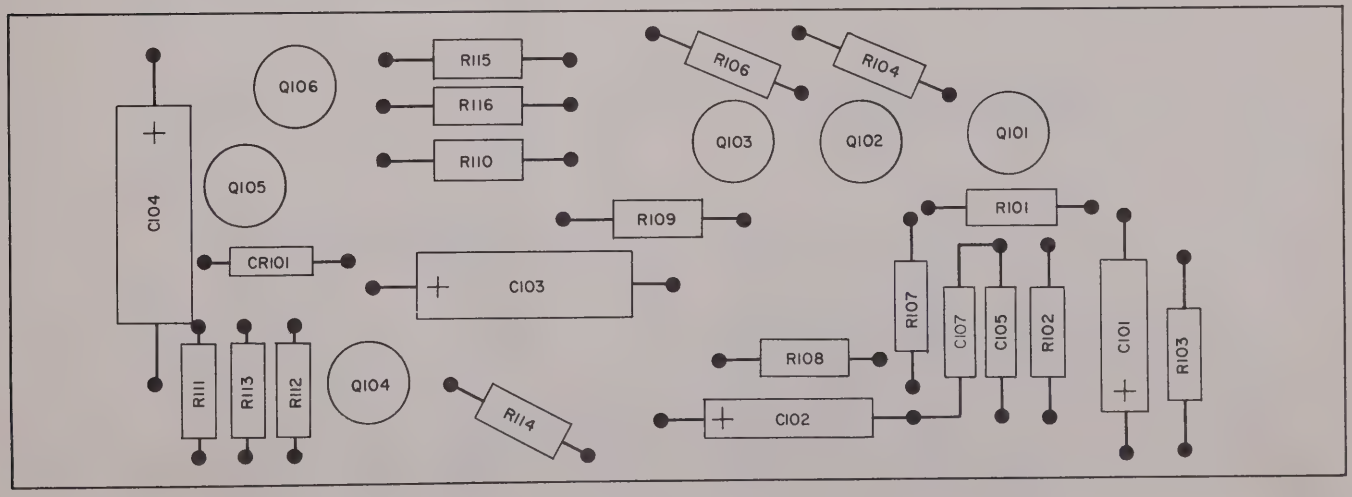


Figure 5-11. Channel A A.F. Oscillator Board Assembly, Location of Components

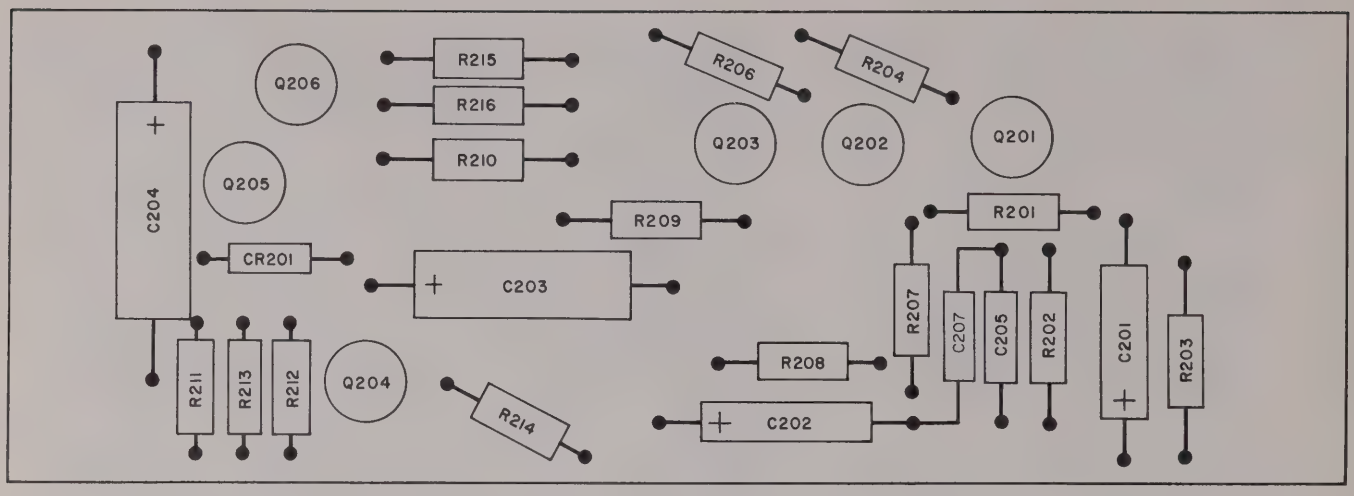


Figure 5-12. Channel B A.F. Oscillator Board Assembly, Location of Components

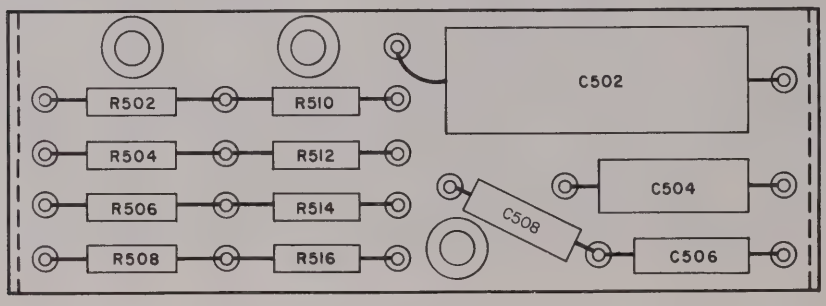


Figure 5-13. Channel A Network Assembly, Location of Rear Components

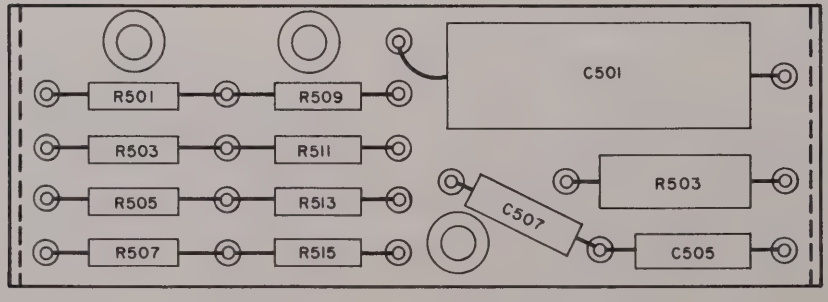


Figure 5-14. Channel A Network Assembly, Location of Front Components

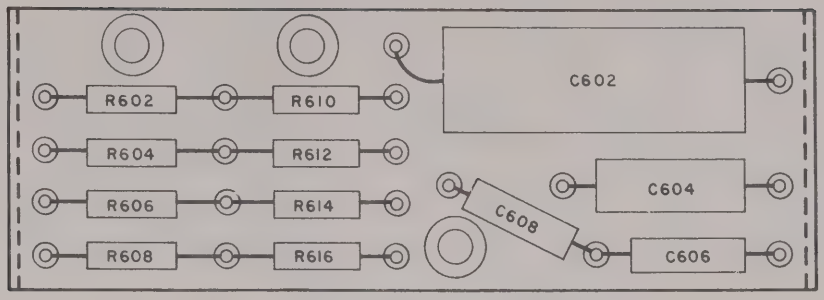


Figure 5-15. Channel B Network Assembly, Location of Rear Components

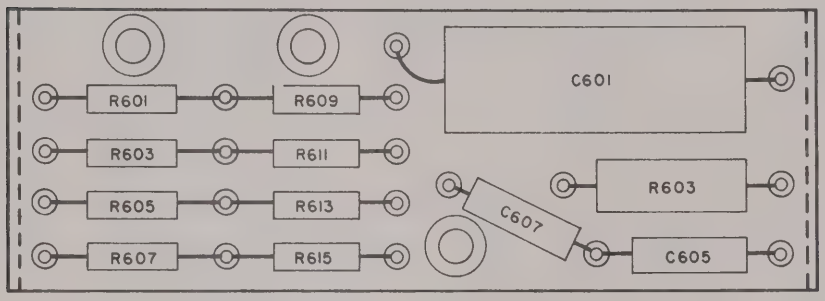


Figure 5-16. Channel B Network Assembly, Location of Front Components

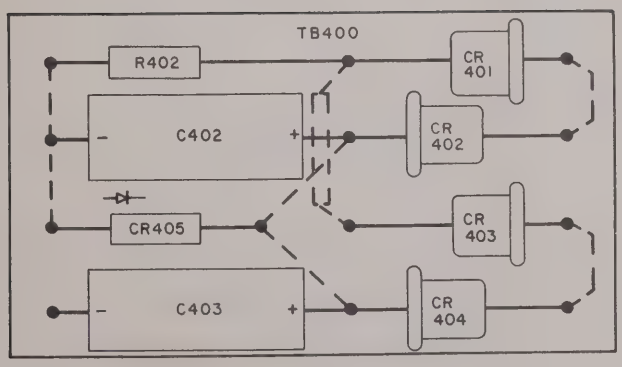


Figure 5-17. Power Supply Circuit Board Assembly, Location of Components

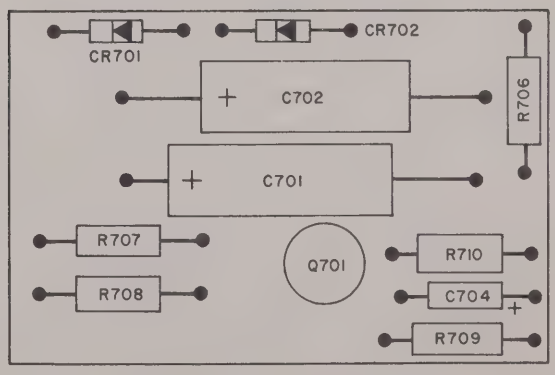
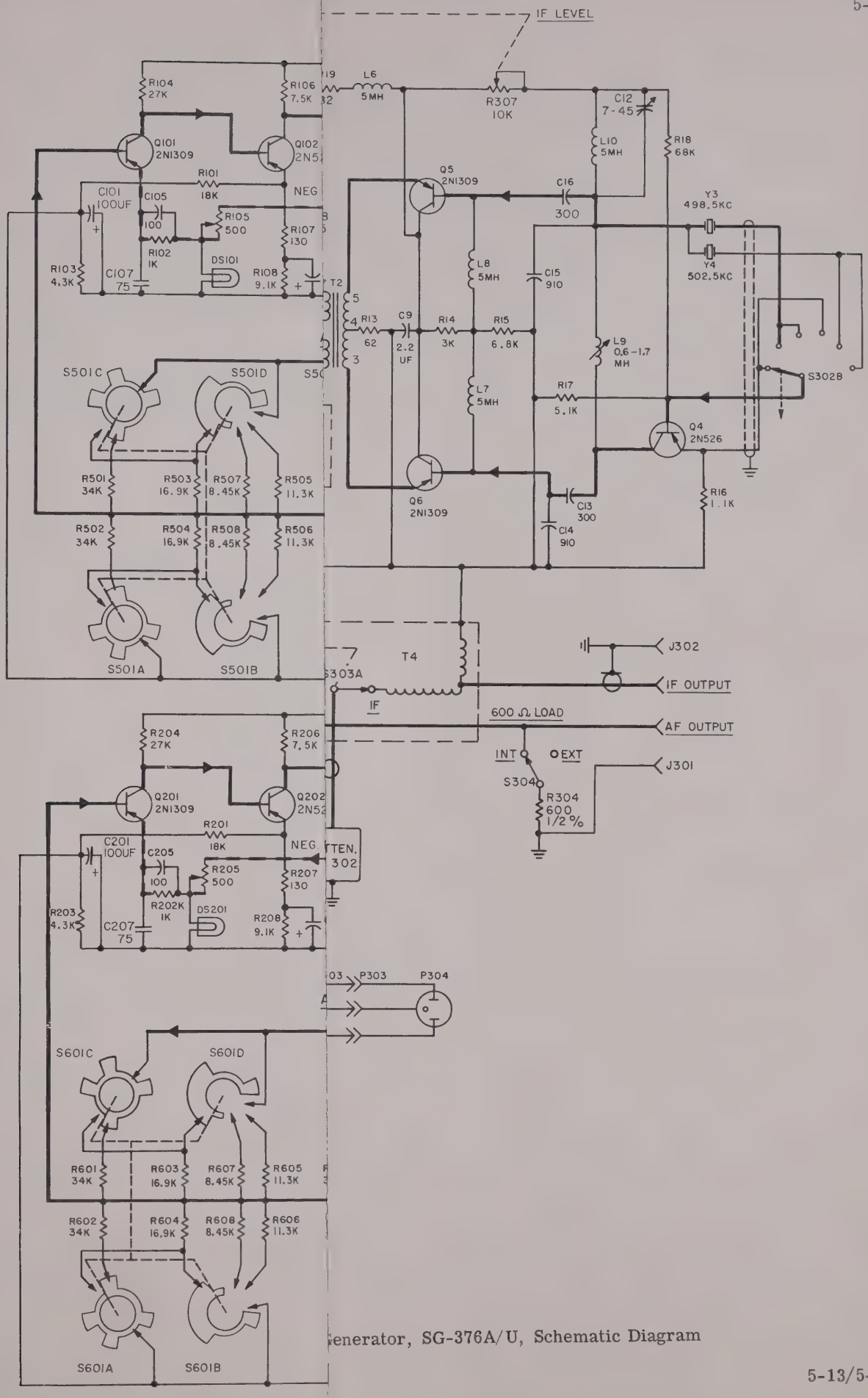


Figure 5-18. Meter Circuit Board Assembly, Location of Components

Figure 5-20



Generator, SG-376A/U, Schematic Diagram

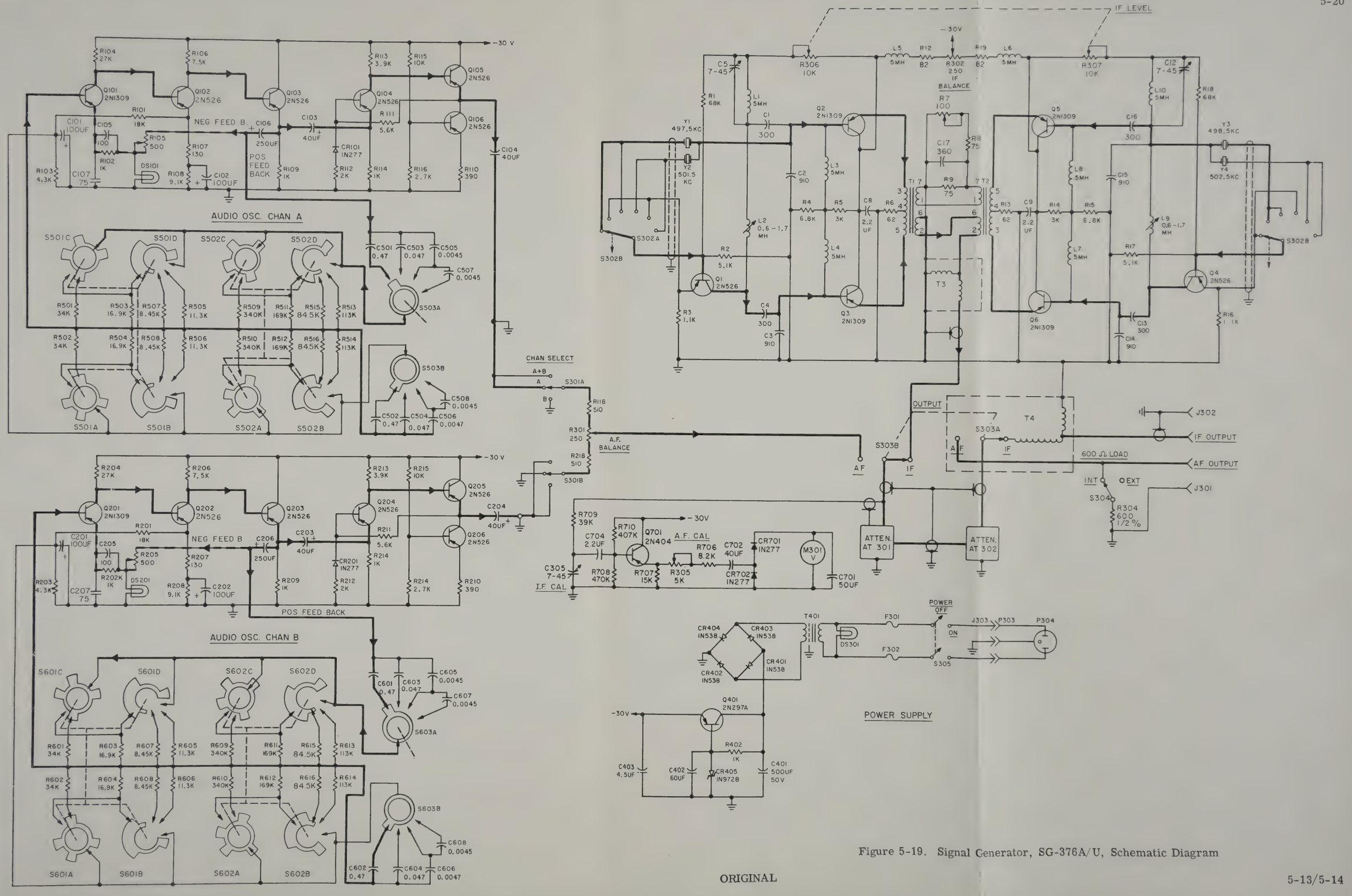


Figure 5-19. Signal Generator, SG-376A/U, Schematic Diagram

SECTION 6

PARTS LIST

6-1. INTRODUCTION.

a. REFERENCE DESIGNATIONS. - Part numbers are identical with drawing numbers.

6-2. MAINTENANCE PARTS LIST.

Table 6-1 lists all subassemblies and their maintenance parts. Subassemblies are listed first as individual items. Maintenance parts are listed alphabetically-numerically. Column 1 lists the reference designation. Column 2 lists the name and description. Column 3 identifies the illustration which pictorially locates the part.

6-3. LIST OF MANUFACTURERS.

Parts designated by Manufacturer's Code No. 06181 are parts supplied by Probescope, Inc., Syosset, N. Y.

TABLE 6-1. MAINTENANCE PARTS LIST

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
SG-376A/U		SIGNAL GENERATOR: Includes transit case and power cable.	1-1
		COMBINATION CASE	
CA-301		CABLE: Power	1-1
A-6		ASSEMBLY, I.F. OSCILLATOR: Board	5-8
A-7		ASSEMBLY, A.F. OSCILLATOR: Board, CHANNEL A	
A-8		ASSEMBLY, A.F. OSCILLATOR: Board, CHANNEL B	5-8
A-9		ASSEMBLY, METER: Board	5-9
A-10		ASSEMBLY, Output SWITCH (S303) Mfg Code 06181	
A-11		ASSEMBLY, POWER SUPPLY: Board	5-9
A-500		ASSEMBLY, NETWORK	5-8
A-501		ASSEMBLY, NETWORK	5-8
A-600		ASSEMBLY, NETWORK	5-9
A-601		ASSEMBLY, NETWORK	5-9
MP-3		NAMEPLATE, IDENTIFICATION	1-1
AT-301		ATTENUATOR: B2645 Mfr Code 06181	5-8
AT-302		ATTENUATOR: B2646 Mfr Code 06181	5-9
AT-303		ATTENUATOR: B1426 Mfr Code 06181	5-9

TABLE 6-1. (Continued)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
C1		CAPACITOR, FIXED: MIL type CM15D301J03	5-19
C2		CAPACITOR, FIXED: MIL type CM20D911J03	
C3		CAPACITOR, FIXED: MIL type, same as C2	
C4		CAPACITOR, FIXED: MIL type, same as C1	
C5		CAPACITOR, FIXED: MIL type CV11D450	
C8		CAPACITOR, FIXED: MIL type CS13AE2R2K	
C9		CAPACITOR, FIXED: MIL type, same as C8	
C12		CAPACITOR, FIXED: MIL type, same as C5	
C13		CAPACITOR, FIXED: MIL type, same as C4	
C14		CAPACITOR, FIXED: MIL type, same as C2	
C15		CAPACITOR, FIXED: MIL type, same as C2	
C16		CAPACITOR, FIXED: MIL type, same as C1	
C17		CAPACITOR, FIXED: MIL type CM15D211J03	
C101		CAPACITOR, FIXED: MIL type CS13AC101K	
C102		CAPACITOR, FIXED: MIL type, same as C101	
C103		CAPACITOR, FIXED: MIL type CL25BG400UP3	
C104		CAPACITOR, FIXED: MIL type, same as C103	
C105		CAPACITOR, FIXED: MIL type, CM05F101J03	
C106		CAPACITOR, FIXED: MIL type CL35BG1UP3	
C107		CAPACITOR, FIXED: MIL type CM05F750J03	
C201		CAPACITOR, FIXED: MIL type, same as C101	
C202		CAPACITOR, FIXED: MIL type, same as C101	
C203		CAPACITOR, FIXED: MIL type, same as C103	
C204		CAPACITOR, FIXED: MIL type, same as C103	
C205		CAPACITOR, FIXED: MIL type, same as C105	
C206		CAPACITOR, FIXED: MIL type, same as C106	
C207		CAPACITOR, FIXED: MIL type, same as C107	
C305		CAPACITOR, VARIABLE: MIL type, same as C5	
C401		CAPACITOR, FIXED: MIL type CE51C501G	5-19

TABLE 6-1. (Continued)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
C402		CAPACITOR, FIXED: MIL type CL65BJ600MP3	5-19
C403		CAPACITOR, FIXED: MIL type CL25BJ4R5UP3	
C501		CAPACITOR, FIXED: B1459-1 Mfg Code 06181	
C502		CAPACITOR, FIXED: Same as C501	
C503		CAPACITOR, FIXED: B1459-2 Mfg Code 06181	
C504		CAPACITOR, FIXED: Same as C503	
C505		CAPACITOR, FIXED: B1459-5 Mfg Code 06181	
C506		CAPACITOR, FIXED: B1459-4 Mfg Code 06181	
C507		CAPACITOR, FIXED: B1459-3 Mfg Code 06181	
C508		CAPACITOR, FIXED: Same as C507 Mfg Code 06181	
C601		CAPACITOR, FIXED: Same as C501	
C602		CAPACITOR, FIXED: Same as C501	
C603		CAPACITOR, FIXED: Same as C503	
C604		CAPACITOR, FIXED: Same as C503	
C605		CAPACITOR, FIXED: Same as C505	
C606		CAPACITOR, FIXED: Same as C50	
C607		CAPACITOR, FIXED: Same as C507	
C608		CAPACITOR, FIXED: Same as C50	
C701		CAPACITOR, FIXED: MIL type CL35BA500MP3	
C702		CAPACITOR, FIXED: MIL type, same as C103	
C704		CAPACITOR, FIXED: MIL type, same as C8	
CR101		DIODE: 1N277	
CR201		DIODE: Same as CR101	
CR401		DIODE: MIL type 1N538	
CR402		DIODE: Same as CR401	
CR403		DIODE: Same as CR401	
CR404		DIODE: Same as CR401	
CR405		DIODE: MIL Type 1N972B	5-19

TABLE 6-1. (Continued)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
CR701		DIODE: Same as CR101	5-19
CR702		DIODE: Same as CR101	
DS101		LAMP: MIL type MS25237-327T	
DS201		LAMP: MIL type, same as DS101	
DS301		LAMP: MIL type, MS25257-6	
F301		FUSE: MIL type MS90078-7	
F302		FUSE: MIL type, same as F301	
J301		CONNECTOR: MIL type UG-1094/U	
J302		CONNECTOR: MIL type, same as J301	
J303		CONNECTOR: MIL type MS3102R14S-7P	
L1		INDUCTOR, FIXED: 2500-62 Mfr Code 99800	
L2		INDUCTOR, VARIABLE: 4000-43 Mfr Code 99800	
L3		INDUCTOR, FIXED: Same as L1	
L4		INDUCTOR, FIXED: Same as L1	
L5		INDUCTOR, FIXED: Same as L1	
L6		INDUCTOR, FIXED: Same as L1	
L7		INDUCTOR, FIXED: Same as L1	
L8		INDUCTOR, FIXED: Same as L1	
L9		INDUCTOR, VARIABLE: Same as L2	
L10		INDUCTOR, FIXED: Same as L1	5-19
M301		METER: B1423 Mfr Code 06181	3-1
MP301		KNOB, POINTED: MIL type MS91528-1P2B	
MP302		KNOB, POINTED: MIL type, same as MP301	
MP303		KNOB, POINTED: MIL type, same as MP301	
MP304		KNOB, POINTED: MIL type, same as MP301	
MP305		KNOB, POINTED: MIL type, same as MP301	
MP306		KNOB, POINTED: MIL type, same as MP301	
MP307		KNOB, POINTED: MIL type, same as MP301	
MP308		KNOB, POINTED: MIL type, same as MP301	3-1

TABLE 6-1. (Continued)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
MP309		KNOB, POINTED: MIL type, same as MP301	5-19
MP310		KNOB, POINTED: MIL type, same as MP301	
MP311		KNOB, POINTED: MIL type, same as MP301	
MP312		KNOB, ROUND: MIL type MS91528-1N2B	5-19
MP313		KNOB, ROUND: MIL type, same as MP312	3-1
P303		CONNECTOR: MIL type, MS310614S-7S	5-19
P304		CONNECTOR: MIL type UP121M	
Q1		TRANSISTOR: MIL type 2N526	
Q2		TRANSISTOR: MIL type 2N1309	
Q3		TRANSISTOR: Same as Q2	
Q4		TRANSISTOR: Same as Q1	
Q5		TRANSISTOR: Same as Q2	
Q6		TRANSISTOR: Same as Q2	
Q101		TRANSISTOR: Same as Q2	
Q102		TRANSISTOR: Same as Q1	
Q103		TRANSISTOR: Same as Q1	
Q104		TRANSISTOR: Same as Q1	
Q105		TRANSISTOR: Same as Q1	
Q106		TRANSISTOR: Same as Q1	
Q201		TRANSISTOR: Same as Q2	
Q202		TRANSISTOR: Same as Q1	
Q203		TRANSISTOR: Same as Q1	
Q204		TRANSISTOR: Same as Q1	
Q205		TRANSISTOR: Same as Q1	
Q206		TRANSISTOR: Same as Q1	
Q401		TRANSISTOR: MIL type 2N297A	
Q701		TRANSISTOR: MIL type 2N404	
R1		RESISTOR, FIXED: MIL type RC20GF683J	
R2		RESISTOR, FIXED: MIL type RC20GF512J	5-19

TABLE 6-1. (Continued)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
R3		RESISTOR, FIXED: MIL type RC20GF112J	5-19
R4		RESISTOR, FIXED: MIL type RC20GF682J	
R5		RESISTOR, FIXED: MIL type RC20GF182J	
R6		RESISTOR, FIXED: MIL type RC42GF820J	
R7		RESISTOR, VARIABLE: MIL type RV4LAYSA101A	
R8		RESISTOR, FIXED: MIL type RC20GF750J	
R9		RESISTOR, FIXED: MIL type, same as R8	
R12		RESISTOR, FIXED: MIL type RC42GF4707	
R13		RESISTOR, FIXED: MIL type, same as R6	
R14		RESISTOR, FIXED: MIL type, same as R5	
R15		RESISTOR, FIXED: MIL type, same as R4	
R16		RESISTOR, FIXED: MIL type, same as R3	
R17		RESISTOR, FIXED: MIL type, same as R2	
R18		RESISTOR, FIXED: MIL type, same as R1	
R19		RESISTOR, FIXED: MIL type, same as R12	
R101		RESISTOR, FIXED: MIL type RC20GF183J	
R102		RESISTOR, FIXED: MIL type RC20GF102J	
R103		RESISTOR, FIXED: MIL type RC20GF432J	
R104		RESISTOR, FIXED: MIL type RC20GF273J	
R105		RESISTOR, VARIABLE: MIL type RV4LAYSA501A	
R106		RESISTOR, FIXED: MIL type RC20GF752J	
R107		RESISTOR, FIXED: MIL type RC20GF130J	
R108		RESISTOR, FIXED: MIL type RC20GF912J	
R109		RESISTOR, FIXED: MIL type, same as R102	
R110		RESISTOR, FIXED: MIL type RC20GF391J	
R111		RESISTOR, FIXED: MIL type RC20GF562J	
R112		RESISTOR, FIXED: MIL type RC20GF202J	
R113		RESISTOR, FIXED: MIL type RC20GF392J	
R114		RESISTOR, FIXED: MIL type, same as R102	
R115		RESISTOR, FIXED: MIL type RC20GF103J	5-19

TABLE 6-1. (Continued)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
R116		RESISTOR, FIXED: MIL type RC20GF272J	5-19
R118		RESISTOR, FIXED: MIL type RC20GF511J	
R201		RESISTOR, FIXED: MIL type, same as R101	
R202		RESISTOR, FIXED: MIL type, same as R102	
R203		RESISTOR, FIXED: MIL type, same as R103	
R204		RESISTOR, FIXED: MIL type, same as R104	
R205		RESISTOR, FIXED: MIL type, same as R105	
R206		RESISTOR, FIXED: MIL type, same as R106	
R207		RESISTOR, FIXED: MIL type, same as R107	
R208		RESISTOR, FIXED: MIL type, same as R108	
R209		RESISTOR, FIXED: MIL type, same as R102	
R210		RESISTOR, FIXED: MIL type, same as R110	
R211		RESISTOR, FIXED: MIL type, same as R111	
R212		RESISTOR, FIXED: MIL type, same as R112	
R213		RESISTOR, FIXED: MIL type, same as R113	
R214		RESISTOR, FIXED: MIL type, same as R102	
R215		RESISTOR, FIXED: MIL type, same as R115	
R216		RESISTOR, FIXED: MIL type, same as R116	
R218		RESISTOR, FIXED: MIL type, same as R118	
R301		RESISTOR, VARIABLE: MIL type RV4NAYSD251A	
R302		RESISTOR, VARIABLE: MIL type, same as R301	
R304		RESISTOR, FIXED: MIL type RN65D6000F	
R305		RESISTOR, VARIABLE: MIL type RV4LAYSA502A	
R306		RESISTOR, VARIABLE: MIL type JD1N056S103UA	
R307		RESISTOR, VARIABLE: Part of R306	
R402		RESISTOR, FIXED: MIL type, same as R102	
R501		RESISTOR, FIXED: MIL type RN65D3402F	
R502		RESISTOR, FIXED: MIL type, same as R501	
R503		RESISTOR, FIXED: MIL type RN65D1692F	5-19

TABLE 6-1. (Continued)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
R504		RESISTOR, FIXED: MIL type, same as R503	5-19
R505		RESISTOR, FIXED: MIL type RN65D1132F	
R506		RESISTOR, FIXED: MIL type, same as R505	
R507		RESISTOR, FIXED: MIL type RN65D8451F	
R508		RESISTOR, FIXED: MIL type, same as R507	
R509		RESISTOR, FIXED: MIL type RN65D3403F	
R510		RESISTOR, FIXED: MIL type, same as R509	
R511		RESISTOR, FIXED: MIL type RN65D1693F	
R512		RESISTOR, FIXED: MIL type, same as R511	
R513		RESISTOR, FIXED: MIL type, RN65D1133F	
R514		RESISTOR, FIXED: MIL type, same as R513	
R515		RESISTOR, FIXED: MIL type RN65D8452F	
R516		RESISTOR, FIXED: MIL type, same as R515	
R601		RESISTOR, FIXED: MIL type, same as R501	
R602		RESISTOR, FIXED: MIL type, same as R501	
R603		RESISTOR, FIXED: MIL type, same as R503	
R604		RESISTOR, FIXED: MIL type, same as R503	
R605		RESISTOR, FIXED: MIL type, same as R505	
R606		RESISTOR, FIXED: MIL type, same as R505	
R607		RESISTOR, FIXED: MIL type, same as R507	
R608		RESISTOR, FIXED: MIL type, same as R507	
R609		RESISTOR, FIXED: MIL type, same as R509	
R610		RESISTOR, FIXED: MIL type, same as R509	
R611		RESISTOR, FIXED: MIL type, same as R511	
R612		RESISTOR, FIXED: MIL type, same as R511	
R613		RESISTOR, FIXED: MIL type, same as R513	
R614		RESISTOR, FIXED: MIL type, same as R513	
R615		RESISTOR, FIXED: MIL type, same as R515	
R616		RESISTOR, FIXED: MIL type, same as R515	5-19

TABLE 6-1. (Continued)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
R706		RESISTOR, FIXED: MIL type RC20GF822J	5-19
R707		RESISTOR, FIXED: MIL type RC20GF153J	
R708		RESISTOR, FIXED: MIL type RC20GF474J	
R709		RESISTOR, FIXED: MIL type RC20GF393J	
R710		RESISTOR, FIXED: MIL type, same as R708	
S301		SWITCH, ROTARY: B1424 Mrf Code 06181	
S302		SWITCH, ROTARY: B1425 Mrf Code 06181	
S304		SWITCH, TOGGLE: MIL type, MS25098-23	
S305		SWITCH, TOGGLE: MIL type MS25100-22	
S501		SWITCH, ROTARY: B1455 Mfr Code 06181	
S502		SWITCH, ROTARY: B1456 Mfr Code 06181	
S503		SWITCH, ROTARY: B1457 Mfr Code 06181	
S601		SWITCH, ROTARY: Same as S501	
S602		SWITCH, ROTARY: Same as S502	
S603		SWITCH, ROTARY: Same as S503	
T1		TRANSFORMER: B1458 Mfr Code 06181	
T2		TRANSFORMER: Same as T1	
T3		TRANSFORMER: C2768 Mfr Code 0618B	5-19
T401		TRANSFORMER, POWER: C1419 Mfr Code 06181	5-19
XF301		FUSE HOLDER, MIL type FHN26B	5-8
XF302		FUSE HOLDER, MIL type, same as XF301	5-9
XC401		SOCKET, OCTAL: MIL type TS101P02	5-9
XT1		SOCKET, MINIATURE 7-PIN: MIL type TS102P02	5-10
XT2		SOCKET, MINIATURE 7-PIN: MIL type, same as XT1	5-10
Y1		CRYSTAL: 497.500KC: B1460-1 Mfr Code 06181	5-19
Y2		CRYSTAL: 501.500KC: B1460-2 Mfr Code 06181	
Y3		CRYSTAL: 498.500KC: B1460-3 Mfr Code 06181	
Y4		CRYSTAL: 502.500KC: B1460-4 Mfr Code 06181	5-19